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THE TELEPHONE IN EUROPE.

Recent statistics covering the use of the telegraph and telephone in Europe indicate that the growth of the former is much less than that of the latter, an effect which is possibly due to the tremendous increase in the use of the telephone. In Denmark, fewer telegrams are sent now than ten years ago, although telephone conversations have increased over five times in as many years. In Sweden, the revenue from telegrams shows but little increase, while the increase in the use of the telephone was, during one year, ten per cent. In Norway, the same conditions obtain. In Germany, there has been practically no increase in the number of telegrams, while the number of telephone messages increased 65,000,000 during the year 1902. In Hungary, the increase in telegrams during the year 1902 was about five per cent. The increase in telephone messages was about fifteen per cent. While the increase in the use of the telegraph is slight, in some cases there being a decrease, the figures seem to indicate that the telephone is replacing it, to a considerable extent, for short-distance messages.

TRANSMISSION OF ENERGY BY MEANS OF GAS.

In a recent paper read before the Birmingham local section of the British Institution of Electrical Engineers, Mr. C. A. Smith compared the distribution of energy electrically and by means of gas. In each case the prime movers were gas engines, and electrical energy was distributed to consumers; but the intermediate stages differed. In the electrical system a large gas-producing plant was operated in connection with a large generating station, from which power was transmitted at 10,000 volts to substations, where it was lowered and partly converted into direct current for traction purposes. In the pure gas system, the gas from the producers was pumped through pipe lines to a number of generating stations, taking the place of the substations of the electrical system. Here generators of different types were driven by gas engines. In order to fix the conditions, it was assumed that power was to be distributed to the city of Birmingham, England, which has a population of about 528,000. The total amount of power required was computed to be 22,000 kilowatts, which was to be divided equally among five substations.

Electrical Transmission.

In computing his results, Mr. Smith assumed that the same gas-producing equipment would suffice for the two cases. Slack coal was to be used, and the ammonia recovered from the process was to be sold. Allowing for interest, taxes and all other items, the cost of the gas was found to be 0.1248 cent per kilowatt-hour. This item of cost is common to both systems. In electrical transmission, three-phase generators were adopted, transmission lines being made in duplicate on the underground solid system, the average distance of transmission being three miles. The total cost of electrical energy at the substation switchboards by this system, including the cost of producing the gas, was computed to be 0.97 cent per kilowatt-hour.

Transmission by Gas.

In the gas-distributing system it was found that, with a consumption of seventy cubic feet of gas per brake-horse-power-hour, and a pressure of one and one-half atmospheres, the diameter of the pipe should be about one and one-quarter feet. The consumption of gas was supposed to allow for a poor load-factor and a poor quality of gas. For distributing mains, riveted wrought iron was adopted. Allowing for all items of expense, it was computed that this system would cost 0.792 cent per kilowatt-hour, being about 0.2 cent per kilowatt-hour less than the electrical system.

Objections to Gas.

This result is apparently in agreement with the opinion which has been heard not infrequently, that gas distribution would be cheaper and more economical than electrical distribution. But are Mr. Smith's figures justified by actual statistics? He is

comparing the results of the electrical system, which has been well tried, and on which there is an abundance of reliable data, with a system which has never been tried. It would probably be found—if his plan of distributing gas were actually carried out—that the results would differ materially from those assumed in the paper; but, aside from this, there are other considerations which should not be overlooked. A public utility, or even a private company, can not adopt methods which are least expensive, irrespective of the effect upon the community; and a saving of 0.2 cent in the cost of generating per kilowatt-hour would hardly compensate a city for the disadvantages and dangers incident to the proposed use of gas. If the electrical companies could disregard the feelings of the public, they would not now have all wires underground. Power stations located at various parts of a large city, and pouring out foul gases in the quantities here proposed, would certainly be considered as public nuisances, while the gas pipes themselves might constitute a real danger. It is probable that our present system of distributing gas in comparatively small quantities for lighting and cooking is the cause of more sickness than is generally recognized. This may be due principally to poor construction of the gas mains; but what would be the effect of a break in a gas pipe supplying 420,000 cubic feet of gas per hour to one of these substations? If the system proposed by Mr. Smith can be shown to be cheaper in actual practice than electrical transmission, it might be used for transmission from a coal mine to a city, but it seems quite unsuitable for distribution throughout a city. In fact, is not any use of gas almost out of place to-day in our cities?

PREPARATION OF STANDARD CELLS.

At the recent meeting of the American Electrochemical Society, held at Washington, D. C., a paper of exceptional importance was read by Dr. Henry S. Carhart, of Ann Arbor, Mich., upon the preparation of standard cells. In this work Dr. Carhart was assisted by Dr. George A. Hulett. The paper gives in detail methods of purifying the materials for use, and of constructing the cell which have—so far, at least—given entire satisfaction. Dr. Carhart's paper appears in full on another page of this issue, and the society is to be congratulated on having received the first report upon the most important improvement in the construction of standard cells that has been made since the Weston cell was first proposed.

Importance of Accurate Primary Standards.

There is but little need to dwell upon the importance of having officially recognized electrical standards of current, electromotive force and resistance, since upon these three depend all electrical measurements. In fact, due to the simple relation of Ohm's law, an accurate definition of any two of the three is sufficient to fix all the units. Of the three quantities, a standard of resistance presents the least difficulty in construction. A column of pure mercury, of accurately known dimensions, answers all the requirements for a primary standard; and of the remaining two quantities, a standard of electromotive force is more satisfactory than a standard of current, since the former represents a definite electrical tension, and the latter is a rate of flow, and hence more difficult to measure. Given a satisfactory standard cell, currents are accurately measured by means of a potentiometer and suitable standard resistances.

The Two Standard Cells.

The standard cell which has received more or less official recognition is the one proposed by Latimer Clark in 1873. The form proposed by Clark has been improved by others, notably Lord Rayleigh and Dr. Carhart, and although in the improved type it has been recognized by several governments, it has not been generally adopted, and the true value of the electromotive force of this cell is still questioned. Other primary cells have been suggested, though but one has met with favor. This is the cell proposed by Mr. Edward Weston, and it is the one dealt with in this paper of Dr. Carhart's. It differs from the Clark cell principally in the substitution of cadmium and cadmium sulphate for the zinc and zinc sulphate. The electromotive force is less than that of the Clark cell, and for this reason is a little more difficult to measure accurately; but this seems to be the only drawback to the new cell, and it is expected that the cadmium cell, under the name of the Weston cell, will be recommended for adoption by the international congress at St. Louis next September to the various governments represented.

Disadvantages of the Clark Cell.

Aside from the question of the absolute value of the electromotive force of the Clark cell, there has always been more or less difficulty in reproducing the cell accurately. The temperature coefficient of this cell is about one-thousandth of a volt per degree centigrade. This would be of little consequence, were it not for the fact that the concentration of the salts in solution can not follow closely the temperature changes of the cell, but always lags behind, making it necessary to keep the cell in a constant-temperature room or allowed to stand where it is to be used for a considerable time before any measurements are attempted. In later types of Clark cell, zinc amalgam is used in place of the zinc rod, but this construction, though an improvement in some ways, increases the mortality of the cell due to expansion of the amalgam, which frequently cracks the glass vessel.

Comparative Advantages of the Weston Cell.

Comparing the Weston cell with the Clark, the temperature coefficient is only about one-thirtieth of that of the Clark cell, this being due to the slight change in solubility of cadmium salts with changes in temperature. With this low temperature coefficient, the hysteresis of the cell, due to changes in temperature, becomes almost negligible. It is reported, also, that the cadmium amalgam does not cause breakage, and it is evident from Dr. Carhart's work that the reproducibility of the cell is at least as good as that of the Clark cell. Indeed, the results of his tests on a number of Weston cells, made from different materials at different times, show a constancy in this respect which, we believe, has never been secured before. While the electromotive force of the Clark cell is usually stated to be

1.434 volts, the third decimal is questioned. The electromotive force of the Weston cell, according to Dr. Carhart, is 1.01937, with a variation of not more than two parts in 100,000. This beautiful result is obtainable only when the greatest care is taken in the preparation of all the materials of the cell. The process described also has the advantage that the cell reaches its final value within a few days after it is set up. The cell, so far as present information goes, is certainly entirely satisfactory for a primary standard, and it is to be hoped that it will meet with favor at the international congress, when, doubtless, Dr. Carhart will be able to give a more extended study of its behavior.

THE LESSON OF INTERRUPTED SERVICE.

Two men and a pot of paraffin, with conditions favorable, caused a tiny blaze in downtown New York the other day, and incidentally put some thirty odd telephone, telegraph and stock ticker cables out of commission. In the telephone cables alone there were involved five thousand lines affecting local subscribers, to say nothing of a number of important long-distance circuits. Owing to the rapid transit construction, the streets of New York city have naturally been in a state of upheaval for some time. This has necessitated first exposing and then shielding with a temporary housing many thousands of dollars worth of current-carrying cables. When the fire from the ignited paraffin was communicated to the planking the inevitable happened, with the above result.

The Subway Should Not Increase the Danger.

Now the subway construction company and the other public service companies certainly have to handle a most difficult engineering problem during these revolutionary changes in taking care of a very live load to the satisfaction of a particular people; so there's no logic in going up in the air, and declaiming against subways in general, for while they're underground they are by no means the root of all evil. When the subway is complete and the proper installation will have been made, every precaution known to modern engineering will be utilized to give stability to the manholes and conduits of the city's underground wiring system.

The Value of Uninterrupted Service.

However, New Yorkers have become so thoroughly devoted to the telephone habit that it is now a vital, but in many cases unappreciated, part of the industrial organism. When five thousand lines go out of service at one jump, without any climatic or atmospheric accompaniment which would lessen the demand for service, the absolute dependence of the average business man upon this method of instantaneous communication becomes convincingly apparent. The direct physical loss entailed by this accident is not very great; the indirect loss and inconvenience can not be measured nor estimated.

There is something military about the promptness with which the telephone and telegraph companies are able to cope with these emergencies, and there is nothing but praise heard on all sides of the efforts which were made to restore the service. This incident has not been all bad if it will have served to impress, first, upon the user the value of a stable service, and second, upon the supplying corporations the necessity of a most painstaking vigilance in maintaining it.

THE NEW WHITE STAR STEAMER BALTIC'S ELECTRICAL EQUIPMENT.

BY GEORGE E. WALSH.

The electrical equipment of ocean steamers has reached the highest state of efficiency in the new White Star liner Baltic, which is probably a type of the future ocean greyhounds that will steadily replace the older ships that were built before electricity had entered so largely into marine architecture. For the past ten years the electrical equipment of ocean steamers had steadily progressed; but it has been only in the recent boats that complete designs could be made to furnish electrical current in all departments for operating lights, doors, machinery and other apparatus. Alterations on many of the older boats were made, and electricity substituted for steam in many ways; but the economy of space and operation could not be obtained thoroughly unless the original designs of the ships were made with this purpose in view.

For this reason the Baltic represents a new type of steamer in which electricity plays a most important part. Her builders planned to use every modern convenience and safety appliance known to marine architecture, and in selecting electricity as the chief motive power for everything except the actual propulsion through the water they sought to adapt it to every possible mechanical work. The result has been to establish a new type of interior equipment that will for some time represent a standard for future designers. It is estimated by the builders that the saving in space through the electrical equipment amounts to fully ten per cent of the whole interior compartments set aside for the machinery and power purposes. There is also an economy of operation and convenience of location by grouping the motors where they are the least in the way that can not well be computed. The comfort and luxury afforded to passengers through the complete electrical equipment of the ship is likewise an important consideration.

Some of the electrical devices installed on the Baltic are new to marine architecture. Most of these are intended to safeguard the ship from accidents and to add to the comfort and convenience of the passengers. One of the most important of these novel electrical equipments is the device intended to prevent collisions at sea. This electrical appliance is peculiarly safe and useful in times of dense fogs. A small clock arrangement on the bridge of the ship shows when another ship comes within the "magnetic field" of the Baltic. Just as soon as a ship enters this field an indicating needle in the clock gives the warning to the navigator on the bridge and it also points in the direction of the approaching vessel. By means of this the steersman knows instantly the danger of a collision in a fog and also the direction to steer to get away from the approaching danger. This electrical equipment is so true and delicate that the approaching steamer's screw revolutions are registered by means of wave vibration and it would be impossible for another ship to creep upon the Baltic in the dark or fog without its presence being indicated.

This fog safeguard is so well arranged and balanced that it can not get out of

order without ringing a bell to announce the fact. A similar registering apparatus is fixed in the captain's room and down in the chief engineer's room. Consequently if the man on the bridge should for any reason be caught napping other officers would be apprised of the approaching danger.

In front of the navigating officer there is arranged other electrical contrivances to keep him intimately posted concerning the condition of his ship at all hours of the night. Should the ship's lights go out an electrical device gives the warning. The lights burning on the bridge instantly go out when for any reason the ship's warning lights are extinguished. Another series of lights indicates to the navigating officer the condition of the bulkhead doors. These are all operated by electric power. Should one of the compartments leak the fact is announced to the officer in charge by the change of lights. A touch of a button would instantly close the doors separating the injured compartment from all others. The control of the bulkhead doors from the bridge brings the question of saving the ship in the case of accident entirely under the control of the officer who is supposed to know the best course to pursue in every emergency. There need be no delay in closing the doors separating the compartments.

Another set of new electrical contrivances installed on the Baltic are peculiar devices for taking the log and sounding the water's depth with the lead. The improvement in this respect is important because it keeps the navigator at all times acquainted with the condition of the water and the speed of the ship. The electric log shows the speed of the ship at all hours to the man on the bridge. The clock arrangement is registering continually. The electric lead likewise announces the depth of the water every time the sounding is taken. A few seconds in taking the depth of the water may mean a good deal in an emergency. There are scores of instances when ships have run on reefs in approaching a harbor through the natural delay in reading the soundings quickly so that the navigating officer could stop the steamer in time. Even when going at half speed a modern steamer passes over a good deal of space in half a minute. By means of the electric lead the sounding can be taken every ten seconds and the record instantaneously reported to the officer on the bridge. The result is he knows at nearly every second of the time how fast his ship is traveling and just how much water there is under her. As a safeguard against danger of grounding there are few devices equal to the electric log and electric lead.

An electric device for registering all signals has also been installed including those of the steam sirens, lights and fog horns. The registering of these signals by an electric device is important in determining what was done on the steamer in accident cases. The reports of officers will be supplemented by the registering devices so that testimony could be verified.

All the usual electrical machinery and devices found on the steamers of to-day are installed on the Baltic and electric buttons are placed in all parts of the steamer to summon waiters or to give warning signals. In addition to these the Baltic is the first steamer to be equipped with a complete electric cooking and refrigerating apparatus. The cooking apparatus is an elaborate and yet simple affair. All the modern inventions for improving this service are provided and the kitchen is cool and clean in the hottest weather. The odors from the kitchen are moreover carried away through pipes in the stern by means of ventilating apparatus operated by electricity. Electric fans are distributed freely over the ship. The electric refrigerating plant enables the steamer to leave the port without any ice other than that required for table use. The saving in the ice plant is not only in money but in space. The Baltic will carry only a fraction of the amount of ice required in most steamers of her size. Electric lights in the cabins and staterooms furnish current for heating and warming water in different parts of the ship. Small electrical chafing dishes and warming pans are furnished for private use in the staterooms so that a sick person can have all the comforts of home, or a chafing-dish party can be given in mid-ocean with as much ease and convenience as in a city apartment or house.

Investigation of the Causes of Commutator Sparking.

Sparking at the commutator of a motor or generator may be due to overload or faulty design. A method of determining experimentally the cause in any particular instance has been devised by M. G. Durville. He uses the stroboscopic action of the sparks when shielded by a revolving slotted screen. Upon the leads of the armature which is to be investigated distinctive marks are placed, so as to identify them. In front of the armature a slotted disc is fastened, which is revolved at about the same speed as the generator armature, but in the opposite direction. The room is darkened, and the machine operated and viewed through the slot in the revolving disc. Under this condition, instantaneous views are obtained of the armature lighted by the sparks at the brush. If the armature is faulty, these sparks will occur when a particular segment is passing under the brush, and the spark at that instant will show the mark upon the corresponding armature lead, indicating that the trouble lies at that point. Care must be taken to mark properly the lead on multipolar machines. If the sparking is due to overload which is constant, the illumination of the armature will be constant, and no particular mark will stand out distinctly; but there are a few conditions where this does not hold, these being in that character of work in which the torque is not uniform during a revolution, such, for instance, as driving a single-acting pump. If the motor is geared to this pump, the temporary overload will probably cause sparking, and seem to show something wrong in the machine; but by shifting the phase of the motor with respect to the pump the indications of trouble will appear at a different point, and thus show it is due to the load and not to a defective winding. The author has tried this method at the shops of MM. Delaunay-Belleville & Company, at Saint-Denis, France, with successful results.

Notes on X-Light, on a Possible Method of Determining the Durability of Book Papers by Exposing Them to Radium.

To the Editor of the Electrical Review:

Radium appears to produce in paper in a short time the same deteriorating effect as age. Probably it is an ionization in both cases. The only papers now known or believed to be durable are the hand-made pure rag papers. These are expensive and can not be used for printing half-tones on account of their rough surfaces. The problem is to find a durable machine-made paper and then have the surface made suitable for half-tones. During an attempt to solve this problem the samples from different American mills were placed on the surface of a constantly revolving disc with samples of the best foreign hand-made papers and subjected to the radiations of pure radium bromide. The results can not be given lest they should be considered as an advertisement of one mill and a condemnation of others, but the method is interesting and new. How useful it may be can be told only after many years.

William Rollins.

Boston, April 7.

TELEPHONE ENGINEERING—II.

BY J. C. KELSEY.

SERIES TRUNK SYSTEM.

When the necessity of the telephone in its relation to modern business methods became apparent to the business man, and he quickly availed himself of its service, as a consequence the business of the telephone company quickly outgrew the capacity of the switchboard. The series board did not have the capacity of the modern board, and 4,000 lines were about all that could be reasonably handled. It became necessary to build a new office to accommodate the increased business, and, located not in the same building but in a distant district, assumed to be the centre of a zone, in order that the lines should not be too long and to facilitate the distribution. The lines in the new exchange district that originally entered the old exchange were changed to the new office, and room given in the old office for new business in its particular district. As long as all subscribers entered one exchange, and all terminated in multiple jacks, it was a quick and easy matter to give connections. When the offices were separated, the problem of giving the subscribers of both exchanges equally good service confronted the engineers, and in a sense it still confronts them.

The lines connecting the two exchanges for the purpose of connecting parties of different exchanges are called trunk lines. The simplest trunk line would be in accordance with Fig. 2, in which each terminal of the trunk line ends in multiple jacks and drops, entering the exchanges, and being operated exactly in the same manner as a subscriber's line.

For the present we will let A represent the old exchange and B the new. This will assume a call originating in the old exchange district for a party in the new district. Of course this process can be reversed, but for purpose of description, one example is sufficient. When the A party calls, by turning the magneto handle, the drop falls before his regular answering operator. She answers him, and receives the order for a B number. She then tests the series of trunk jacks until she finds one that is not busy. When one is found she plugs in, and rings on the trunk line, exactly as on a subscriber's line. The drop thereupon falls at the B exchange, and the operator answers and asks the subscriber for the second time what number he wants. This would be the easiest operating, even from the subscriber's standpoint. The operator at A could tell B the number wanted, but the A subscriber would hear it, unless A pulled out the plug. That would take time, and our whole future development along trunk work is to save time. Hence, the operator left the subscriber to repeat his desired number. This method simply meant that a trunk call took twice the time that a direct exchange call did.

Before studying devices that would reduce this double time taken, let us look

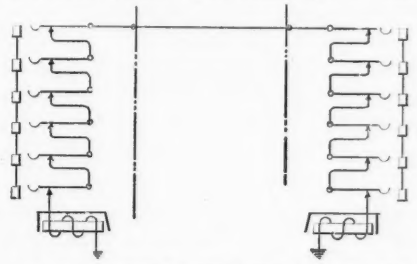


FIG. 2.—SIMPLE TRUNK LINE—A OPERATOR AT LEFT; B, AT RIGHT.

into other, and equally objectionable, features of this trunk. As trunks are generally too busy, the first bad feature would be the time lost in testing until a jack was found that was not busy. A second bad feature would be due to the natural imperfections of the series system busy test. In order to make a test of a busy line, the sleeve or thimble must be grounded. That ground is put on the thimbles by the short-circuiting of the solid plug, of the line spring and the thimble, through the subscriber's instrument. So that every test made on a line that is busy causes the clicks to be made in the talking subscriber's receiver. On a trunk connection, there would be two parties talking, and we may easily assume that ten trunk lines are busy at the same time. The trouble would not only be from

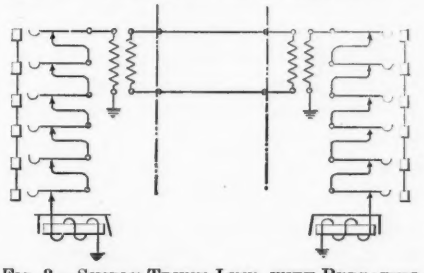


FIG. 3.—SIMPLE TRUNK LINE, WITH REPEATING COIL INSERTED—A OPERATOR AT LEFT; B, AT RIGHT.

one operator testing, but from all the others in the A exchange, and forty operators may be assumed to be at A.

Another bad feature would be the complete disconnection of the trunk line within a reasonable time. The time taken for actual talking, hardly ever over three minutes, is not the only usage of the trunk. If it took three minutes to get the trunk line completely disconnected so that it could be used again, then it is plain that the telephone company has to maintain twice the number of necessary trunks for talking purposes. Time saved on disconnection cuts down the number of trunks materially. We have considered that A has called B, and it has taken twice the time that a direct call would take because two operators have relayed the call, in exactly the same manner. When A and B are through talking, one of them may be assumed to ring off. It will throw down the series drops in both exchanges, giving simultaneous notice to both operators that the connection is no longer desired. Not much time is lost in this case. Now, suppose that neither A nor B rang off, then each operator was left to her own leisure. We will suppose that A pulls down her cords first. At an instant later, another A operator, in testing for a trunk, finds the trunk no longer busy. She will plug in, and ring. The drop would not fall, because B has cut it off by the entrance of her plug. But the B subscriber's line is still on connection, and the ringing on the trunk will call him back to his instrument, only to find that he is not wanted at all. Both subscribers will frantically ring off, and A will then try to test out another turnk line. She will ring, and may ring down the trunk drop in front of B, if it is clear. Here we have a trunk out of service, two subscribers delayed, or angered, and another trunk put into service on account of one call.

Now suppose that B pulled down the connections of her trunk connection and A did not, the trunk would be put out of commission, because it had a busy test placed upon it. If it had not a test placed upon it, then the A operator along the multiple would ring down the trunk drop at B, and also call back the last A party using the trunk.

The worst feature in a busy system would be the two-way trunk. There would be an incessant calling back of subscribers who had not been disconnected simultaneously. If there was a device that would place a busy test on both terminals until the last plug was pulled out, the trouble would be remedied. There are times when A and B operators would plug in, and would ring against the other on the same trunk. The result would be more time lost.

The first time-saving feature was use of one-way trunks. Instead of compelling B to insert her answering plug to answer a call, the trunk was made to terminate in a calling plug, so that she could test a trunk directly and insert the plug. To save the time lost in the ceaseless testing

for trunks not busy, an order wire was used, so that B operator herself could tell the A operator what trunk to use. This was easily done, as all the trunk plugs were placed in front of one B operator. She could tell instantly, as she generally had a plug in her hand ready for use. The order wire was connected directly to her receiver, so that the A operator could have instant communication by simply pressing the order button, which placed her operating set in direct talking relation. The order wire was full metallic, as it had to be very quiet at all times.

According to Fig. 2 the trunk is a two-way circuit, ending in jacks and drops at each exchange. It was a grounded circuit, and was very noisy after the advent of the trolley cars. To prevent the earth currents, due to the difference of potential of the two exchange grounds, the repeating coils were placed as shown in Fig. 3, and made no change in the operation of the trunk. These repeating coils paved the way for the operation of the trunk disconnecting signals.

According to Fig. 4, which illustrates a one-way, order wire, trunk connection between the A and B subscribers, there are repeating coils in both trunk and order wire circuits. That ensured quiet lines as far as they were locally concerned. When the A party called, he rang down his line drop, and was answered by his regular operator. Upon calling for a B party, the operator presses the order key O. K., which puts her telephone set in connection with the B operator, saying, for instance, 50. The B operator responds, saying No. 1, meaning that A is to use the first trunk. A plugs into trunk No. 1, and pays no further attention to the call. B picks up the plug of trunk No. 1, opens her listening key, tests the line jack of subscriber No. 50, finding it not busy, rings on the line. When the A and B parties have finished talking they ring off. If clearing-out drops exist on each cord circuit, then there will be no simultaneous pulling down of cords by A and B. So far, no advantage has been gained. Now, since the A operator started the call, why not give her control of it, and hold her responsible for the completion and disconnection of the connection. This the series system did.

To give the A operator the control of the connection absolutely, they removed the clearing-out drop from the B single cord and plug circuit, then when parties rang off not a sign of it did B receive. She had no way of finding out, except by listening in, and she was too busy for that. The connection was ordered up by the A operator, why did they not let the A operator order it down just as she ordered it up? But the order wire was already too busy, and it was not at all advisable to use it for disconnecting. So they put in a mechanical signal MS, in Fig. 4, arranged with a grid, so that when it was normal a black face was exposed; when actuated, a white face was shown, which was easily visual. To actuate this signal, it was necessary to use the trunk for that purpose. To use the trunk, it was necessary to make an arrangement that would permit the talking current and the actuating current to pass over the line at the same time. This was accomplished by tapping the middle points of the line side of the repeating coils, so that the current entering at the middle point of the coils neutralized the repeating coil core, as far as the actuating current was concerned. At the B end the middle tap was connected to the magnetic signal, thence to ground. At the A end the multiple jack springs were arranged so that when the plug entered the jack the movement of the main spring caused two insulated springs to be thrown in contact. One of the springs was connected to the repeating coil at A, and other to battery and ground. The entrance of the A plug caused a current to flow from the battery at A to the middle point of the repeating coil, thence over both sides of the trunk line to the middle point of the B repeating coil, thence to the magnetic signal and ground, thereby actuating the signal and causing it to show a white face to the B operator. This told B that A had taken the trunk named. Then she could test, and ring out on the desired subscriber's line, with the knowledge that the connection would be complete. When the parties finished conversation, either one happening to ring off threw down COD, the clearing-out drop at A. Thereupon A challenged the line, and if no further connection was wanted over the trunk line she withdrew the plug. That act opened the battery circuit of the magnetic signal, operating the magnetic disconnect signal, and B pulled down the connection immediately after A. This is the principle of trunk work to this day, except a few additional things made possible by the common battery. This disconnect signal reduces the chances of ringing back subscribers to a minimum, place the trunk in a position for immediate use, and thereby reduces the number of trunks to a considerable degree.

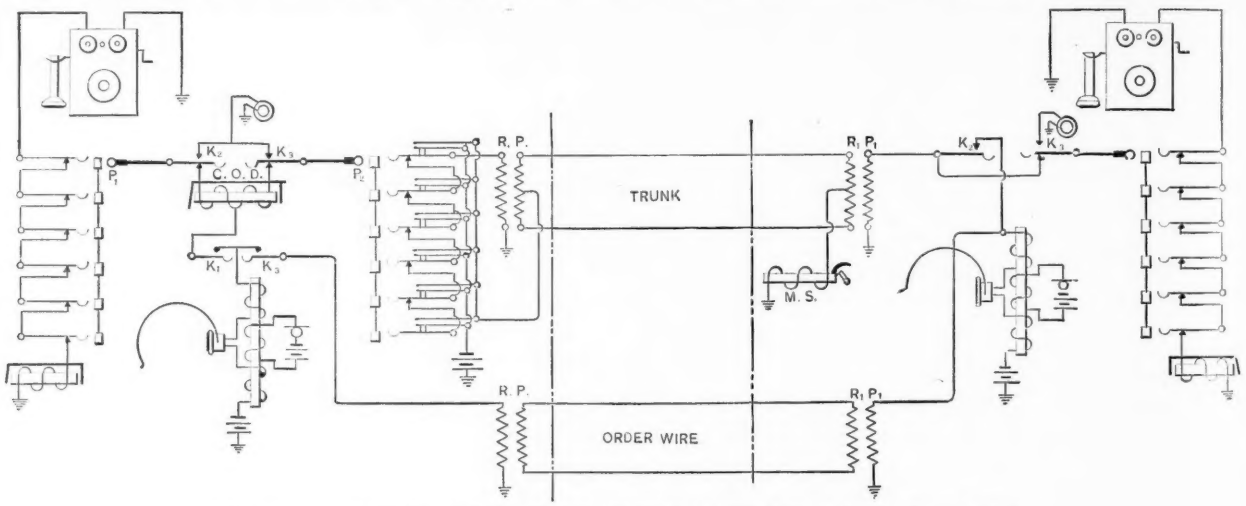
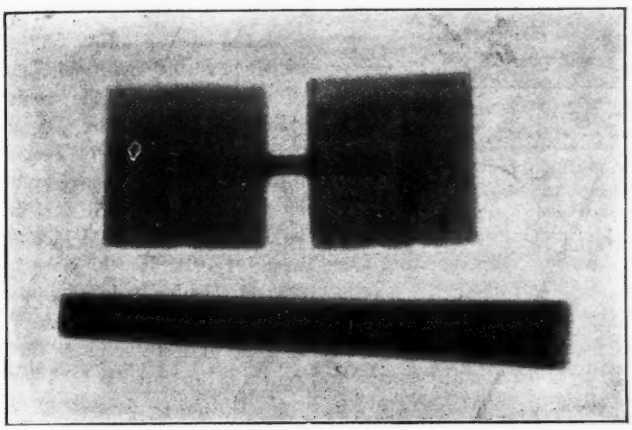


FIG. 4.—ONE-WAY, ORDER-WIRE, TRUNK CIRCUIT—A OPERATOR AT LEFT; B, AT RIGHT.

On the whole, the series grounded system served as the most important link between the earliest practice and the very latest. For several years the weakness of the system was generally known to both engineers and operators, and the adoption of what is called the self-restoring drop system did not satisfy the demands, so that the companies worked the series system to the last ditch waiting for the common battery developments, which had been so long promised. But the self-restoring drop system served a fairly great purpose, and will be taken up as the next link in the chain of telephonic development.

An Interesting Radioactive Experiment on Cast Iron.

In a note published in the *Journal* of the Franklin Institute, for April, Mr. Alexander E. Outerbridge, Jr., calls attention to the following interesting experiment made by Messrs. Williams, Brown & Earle, of Philadelphia, with radium bromide of high activity, imported from Paris. This shows that emanations from this element will penetrate cast iron readily.



An Interesting Radioactive Experiment on Cast Iron.

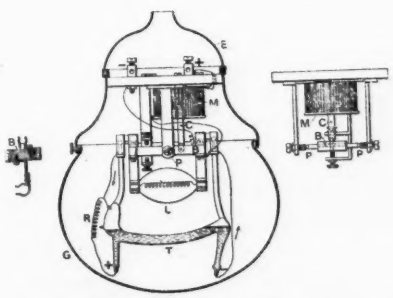
In the half-tone illustration herewith, two pieces of a cast-iron test bar was cut to a thickness of one-sixteenth of an inch. One of these pieces was left in its normal condition, and the other considerably expanded. They were laid upon a strip of lead (a metal which is almost impermeable to the emanations from radium) cut to a sort of dumb-bell shape. A tube containing 100 milligrammes of radium of 10,000 activity was placed centrally, by measurement, four inches above the pieces of cast iron. A wedge-shaped piece of steel of the same thickness was placed close to the cast-iron pieces for comparison, steel being less permeable to these emanations than cast iron. After an exposure of thirty-eight hours, the negative which was placed beneath these objects was developed and a print made therefrom.

Several curious and interesting phenomena may be noticed. The rays passed through both pieces of cast iron, but were intercepted by the lead strip, making a distinct image of the lead strip underneath the cast iron.

The central portion of the lead exposed to the rays between the two pieces of cast iron appears narrower than the portion seen through the cast iron, and looks more like a round rod than a flat strip. Also, penumbras show around the edges of the cast iron and steel indicating that the rays are, in some degree, deflected around the edges.

A New Mercury Vapor Lamp.

A new type of mercury vapor lamp has been brought out in England by Messrs. C. O. Bastian and A. E. Salisbury. The former has been working for some time on lamps of this type, and has at length evolved one which possesses several features of novelty. This is described in the London *Electrician*, from which the drawing and following description are taken.



A New Mercury Vapor Lamp.

This drawing shows the lamp in its normal position. E is a spun copper bell-shaped cover which protects the internal mechanism from wet, and provides a means for suspending the lamp and fixing the tubes and other devices. G is an ordinary glass globe. As shown in the illustration, the lamp is not at work and it will be observed that the mercury in the tube T connects together the two wires sealed into the glass. Fixed to one end of the glass tube is an iron plunger C which acts as a core to the electromagnet M. Now, it is obvious that if the switch were closed with merely the column of mercury in the circuit the only result would be to blow the fuse, and therefore the resistance R, the electromagnet M, the carbon filament lamp L and the mercury in the tube T are all connected in series. On closing the switch, the core C is drawn up by the electromagnet, T being pivoted at P, and the continuity of the mercury being broken, an arc is formed. It will thus be seen that the tilting of the tube is effected automatically instead of by hand, as in other forms. But the mere tilting is not sufficient to effect all that is necessary, for the resistance R has to be short-circuited, and this, again, is brought about automatically. To fill the left-hand bulb of the tube with mercury merely by tilting would be inexpedient, as the tube would have to be brought into a position approximating the vertical. Happily, the pressure of the mercury vapor set up by the arc forces the mercury up into this bulb, and thus cuts out the auxiliary resistance. All these operations occupy but a fraction of a second, and there is no "time-lag" in the starting of the lamp.

A more or less successful attempt to overcome the absence of red rays has been made by fixing the carbon filament lamp L just above the mercury tube. This lamp is under-run and its radiation is consequently rich in the required red rays.

The patentees claim an efficiency of two and one-half candle-power per watt when the carbon auxiliary is not used, and 1 to 1.5 candle-power per watt when the latter is used. Each lamp requires from forty to sixty volts and 0.65 of an ampere, and the candle-power is said to be eighty. Lamps have been run both continuously and intermittently for over 1,500 hours, and the inventors believe that the average life will be about 3,000 hours. Although they hope that there will be a demand for the lamps for indoor lighting, the principal object is to provide an electric lamp for side street lighting which will compete successfully with incandescent gas lighting.

An Electric Railway from Rome to Naples.

A route has been surveyed for an electric railway from Rome to Naples. This route runs from Rome across the Pontine marshes to Terracina, and thence to Formio, and finally to Naples. Energy will be derived entirely from water power, mainly from the Tiber and the Volturo rivers, the latter river almost bisecting the line, and being capable of supplying the greater part.

Railways in Mexico.

The Mexican department of public communications and works has issued a complete and detailed statement of all the railways—steam, electric and animal traction—existing in Mexico at the close of last year. The total amounted to 16,113 kilometres, equivalent to 10,007 miles. Of this total, 15,953 kilometres are operated by steam only, and 12.75 kilometres electrically. There is also a group of 241 kilometres which is operated by steam, electricity and animals.

SINGLE VERSUS MULTIPHASE GENERATORS IN ALTERNATING-CURRENT RAILWAY WORK.

BY W. A. BLANCK.

The present great interest in the development of alternating-current railways makes most timely some considerations as to the selection of the generators delivering the energy to the system, particularly the choice between single and multiphase machines.

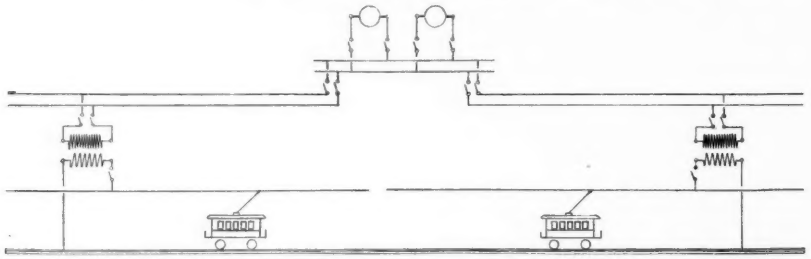


FIG. 1.—SINGLE VERSUS MULTIPHASE GENERATORS IN ALTERNATING-CURRENT RAILWAY WORK.

If the road to be equipped with the alternating-current system takes its current from a power-house in which polyphase apparatus is already installed, it would be natural to supply the various sections of the line from the different phases of the generators. However, in case of an entirely new installation the use of single-phase generators may be more advantageous, notwithstanding the greater cost of the single-phase as compared to the multiphase generator of equal capacity, some of the relative merits of the two systems will now be considered.

For the purpose of discussion, three typical cases have been chosen, shown by diagrams 1, 2 and 3. In each case 20,000-volt generators are assumed to feed directly in to the high-tension bus-bars, thus simplifying the diagrams by the omission of the step-up transformers. High-tension switches connect the bus-bars to the transmission lines leading to the stated substations. In the substations are installed the step-down transformers with primaries connected to the transmission line by high-tension switches. Single-pole switches are inserted between one side of the 3,000-volt secondaries and the trolley wire, while the other side and the transformer case are tied to the rail. The power-house is located at the centre of the line, which is divided into sections as the case may determine. These sections are separated by suitable insulators, and arrangements are provided for readily connecting them by jumpers in case of emergency. A simplification of these cases is also shown in corresponding diagrams designated A, which is accomplished by using the rail as a common return for both primary and secondary circuits. It will be noted that in case this is done with the three-phase generators, 34,000 volts must be delivered to the bus-bars in order to maintain 20,000 volts between the transmission line and the grounded neutral.

In case 1, using a single-phase system, it is necessary to install double-pole switches on the transmission line both in the power-house and substation. Normally the static strain between the transmission line and ground will be half of the impressed voltage. In case 1 A with a single transmission line, it is only necessary to use single-pole switches in all primary circuits, thus effecting a very material saving in the expense of high-tension switches as well as the saving of fifty per cent in transmission line copper and insulators. It will be noted, however, that this arrangement subjects the transmission system and transformers to the full static strain of the impressed voltage. This will call for somewhat greater care in insulation of the transformers and will continuously subject the insulators of the transmission line to a higher strain.

The decreased number of insulators with the corresponding decrease in points at which failure can occur, however, tends to counterbalance the somewhat more rigorous requirements.

Should it transpire that one line is grounded in case 1, the system can still be operated until such time as repairs can be made, while in case 1 A such a failure would necessitate the shutting down of that particular transmission line. This condition, however, is exactly analogous to that of a three-phase system now so generally operated with a grounded neutral.

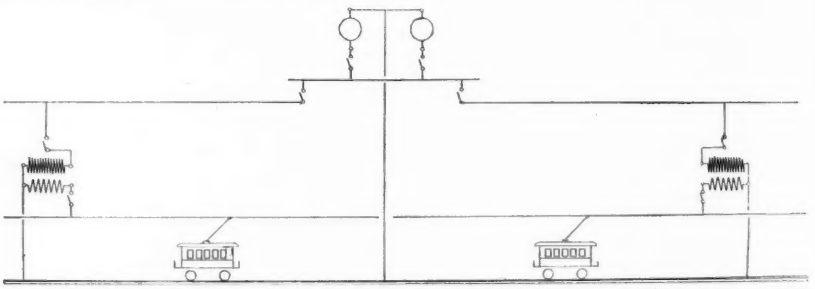


FIG. 1 A.—SINGLE VERSUS MULTIPHASE GENERATORS IN ALTERNATING-CURRENT RAILWAY WORK.

When the system depicted in Fig. 1 is in normal operation, the adjacent sections are at the same potential and the section insulators are subjected to no strain whatsoever, while if one section is shut down the insulator will have to withstand the full trolley potential of 3,000 volts.

Should any one section of the transmission line or any one substation be put out of commission, it is possible by use of the jumpers mentioned above to feed the disabled trolley section from each of the adjacent sections, thus maintaining service without excessive drop.

A very important feature in the operation of this system is the fact that the full generator capacity is available at any point on the system, thus making it possible to take care of any unbalance in the distribution of the load, due to the congestion of traffic at any point of the system.

In case 2 the use of two-phase generators is considered. This will be most advantageous when applied to a system consisting of a single line with the power-

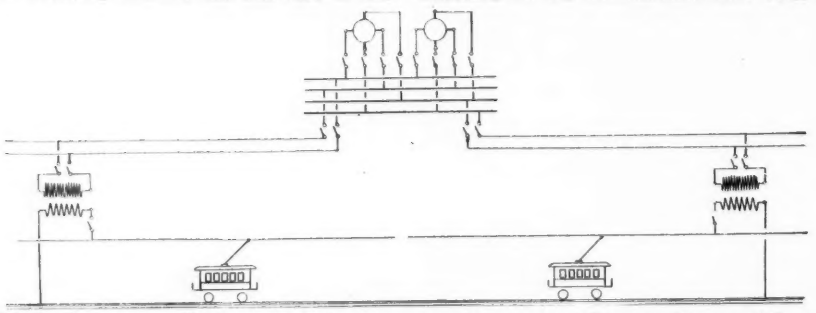


FIG. 2.—SINGLE VERSUS MULTIPHASE GENERATORS IN ALTERNATING-CURRENT RAILWAY WORK.

house located at the centre. Current will be supplied to one end of the system from one phase of the generators, while the second phase feeds the other end.

In comparing the cases 2 and 2 A the conditions are exactly similar to 1 and 1 A so far as the saving in switches, copper and insulators and the static strains are concerned.

However, a noticeable difference exists so far as operation is concerned. Since the adjacent sections are fed by different phases, the section insulator must stand 4,200 volts when in normal operation. In case one section of the transmitting system is disabled, current can be supplied by means of jumpers only from the adjacent sections supplied by the same phase, which will result in double the drop due to similar occurrence in case 1.

Since the section of the system fed by the different phases will be entirely separated, this arrangement does not provide for an unbalance in load so well as in case 1. In fact, only fifty per cent of the generator capacity is available on either section, a point of considerable importance in practical operation.

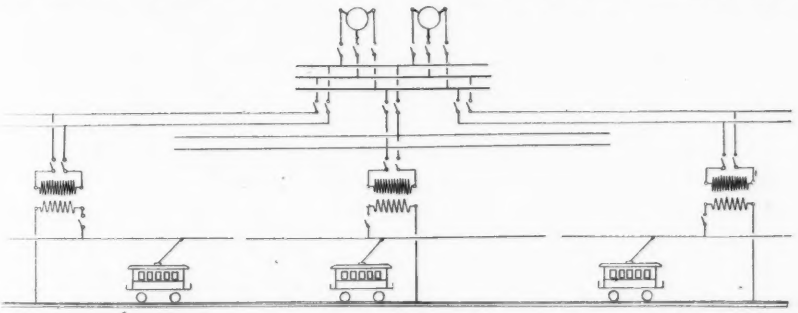


FIG. 3.—SINGLE VERSUS MULTIPHASE GENERATORS IN ALTERNATING-CURRENT RAILWAY WORK.

In case 3 the application of three-phase generators to the single-phase system is considered. This arrangement is best adapted to a railroad system consisting of main line and branch, with the power-house located at the junction, since it will then be possible to feed the section without overlapping the transmission lines. Again, similar relations hold between 3 and 3 A as between 1 and 1 A, so far as the saving in switches, copper and insulators and the static strains are concerned.

The insulators, separating sections fed by different phases, have to withstand 5,200 volts as compared with the 4,200 volts in case 2. The same limitation in feeding any section of the trolley from its adjacent section in case of disabled transmission line holds as in case 2. So far as available generator capacity for any section is concerned the two cases are materially different. In case 3, due to the delta connection, it is possible to utilize sixty-six per cent of the generator capacity in any section, whereas in case 3 A with the star-connection only thirty-three per cent of the generator capacity is available on any one section.

It is evident that on account of the high potentials, section insulators must be of considerably greater length than those now used on the low-voltage trolleys, approximately from four to six feet in length. This will have a very appreciable effect on the lights when the car passes the section insulator, as well as presenting the difficulty in starting which would arise should the car come to rest under the insulator. Moreover, the arcing due to the interruption of the current on the high-voltage trolley is apt to prove serious.

All of these difficulties can be overcome in case 1 by the use of two trolley bows, one mounted over each truck of the car.

Since these will more than span the section insulator, the current will not be interrupted, thus materially improving the operation of the system.

This arrangement with the two bows can only be applied in case 1, as in cases 2 and 3 it would not be permissible to short-circuit two sections fed by different phases, which leaves the latter cases subject to the difficulties above mentioned.

A metallic circuit telephone system installed on the same poles as the grounded high-tension line will be subjected to higher static strain and greater inductive action than in the case of the ordinary transmission line. The effect of induction can be overcome by frequent transposition of the telephone wires. To guard against shocks due to static strains, care must be taken to provide perfect insulation for the telephone instruments, as well as for the person using the telephone.

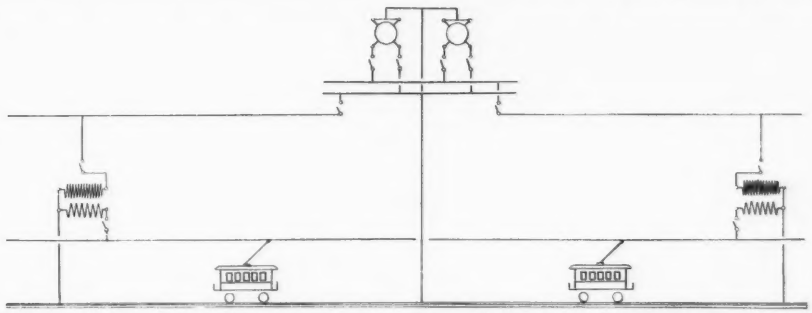


FIG. 2 A.—SINGLE VERSUS MULTIPHASE GENERATORS IN ALTERNATING-CURRENT RAILWAY WORK.

From the foregoing discussion, it appears that it will be entirely possible to use two and three-phase generators now installed to furnish power for single-phase systems, but that the difference in potential between sections and the small generator capacity available on any section are serious obstacles to the satisfactory operation with this arrangement.

Where entirely new apparatus is to be installed, it is undoubtedly better to use single-phase generators. Their first cost is somewhat greater, but the system is far more flexible in its ability to handle unbalanced load conditions, and with the double-bow trolley gives perfectly continuous service over section insulators.

While the suggestion to use rail as common return for both high-tension and trolley circuits is a radical departure from current practice, it does not involve greater risks for personal injury or the continuity of the service than in the ordinary three-phase system with grounded neutral.

The immense advantages of simplification and decrease in the expense of the transmission system most imperatively bespeak for this feature most careful consideration.

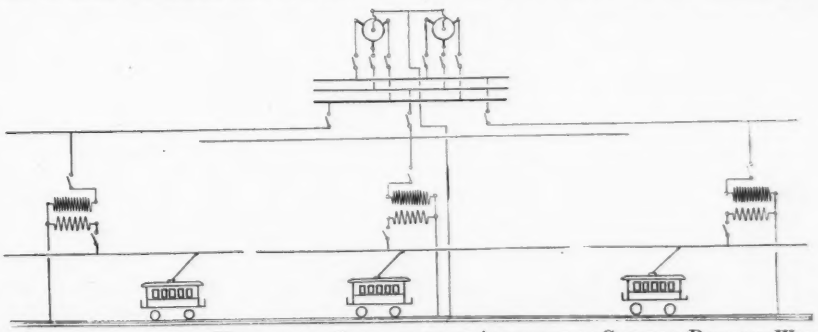


FIG. 3 A.—SINGLE VERSUS MULTIPHASE GENERATORS IN ALTERNATING-CURRENT RAILWAY WORK.

PREPARATION OF MATERIALS FOR STANDARD CELLS AND THEIR CONSTRUCTION.[1]

BY HENRY S. CARHART AND GEORGE A. HULETT.

In the preparation of standard cells the chemical side of the problem has hitherto received too little attention. The attempt to obtain more concordant results by giving more attention to the purity of the materials used has led us to investigate the mercurous sulphate, which serves as the depolarizer. The essential results so far obtained will be included in this paper, though the work is not yet completed. We will first describe our method of preparing the other materials.

MERCURY.

The mercury was first shaken with a nitric acid solution of $AgNO_3$, using separating funnels, and was then distilled several times in a vacuum. It is easier to prepare mercury in a high state of purity than the other materials.

CADMIUM SULPHATE.

The chemically pure commercial salt was dissolved at room temperature in its own weight of distilled water with the aid of a motor-driven stirrer. If it was found to be acid to congo red, it was shaken with cadmium oxide, then filtered, and the clear solution was placed in a large crystallizing dish in a room as free from dust as possible. The crystallization is a slow process, but, if carried out as indicated, it will yield perfectly transparent crystals. After about two-thirds of the liquid has evaporated, the mother liquor is poured off and only the clear crystals are taken; those that are white or colored are redissolved, the solution added to the mother liquor, and the whole is then filtered and left to crystallize.

In working up about five kilogrammes of $CdSO_4 8/3 H_2O$, the final 100 cubic centimetres of mother liquor contained only the merest trace of zinc; and the zinc, which was the chief impurity to be feared, would be in this last mother liquor, since zinc sulphate is not isomorphous with cadmium sulphate.

The above result indicates that the best chemically pure cadmium sulphate to be had in the market is practically free from zinc.

The method of slow crystallization yields exceptionally clear homogeneous crystals; and these crystals dried on filter paper were used in all our work.

In making a solution of the cadmium sulphate crystals, the difficulty of a very slow rate of solution is encountered. To avoid the formation of another hydrate the solution must not be heated above forty degrees. The weighed crystals are brought into an Erlenmeyer flask and covered with three-fourths their weight of distilled water. A Schultz stirrer (Ber. d. d. Chem. Ges., 1896, 2883) is driven by a motor so as to cause the water to circulate just over the crystals for a half day or so, preferably in a bath at twenty-five degrees, controlled by a thermostat. It is best to provide the Schultz stirrer with metal bearings, since glass is liable to abrade. A saturated solution can be made in this way with certainty; some of the crystals will be left and the supernatant solution will be perfectly clear, and will remain so indefinitely. We have found it entirely unnecessary and undesirable to treat the solution as above prepared with cadmium oxide and mercurous sulphate, as has often been advised.

CADMIUM AMALGAM.

A large crystallizing dish is nearly filled with a cadmium sulphate solution, nearly saturated and slightly acid with H_2SO_4. In a small low crystallizing dish is placed a weighed quantity of pure mercury and the whole is immersed in the cadmium sulphate solution, the mercury to serve as the cathode. Connection is made with it by means of a glass-protected platinum wire. The anode consists of pure cadmium, also placed in a small crystallizing dish to catch the dust coming from the disintegration of the cadmium. The fall of potential from anode to cathode should not exceed 0.3 volt; an ammeter is used to keep a rough account of the quantity of electricity which flows until something more than the necessary amount of cadmium has been deposited. The crystallizing dish, with the amalgam and some of the solution, is then removed and is warmed over a water bath till the amalgam melts under the cadmium sulphate solution. When cool it forms a beautiful crystalline button, free from oxide and dust. It may be washed, dried on filter paper, and weighed. The necessary amount of mercury to make a 12.5 per cent cadmium amalgam may finally be added. It should then be again melted under the cadmium sulphate solution and stirred to ensure homogeneity. It will keep indefinitely.

MERCUROUS SULPHATE.

Recently, both in this country and in Europe, variations in the electromotive force of standard cells have been traced to the influence of the mercurous sulphate. But little attention appears to have been given to the problem of working out a standard method of preparing this depolarizer.

Mercurous sulphate can be made by the action of H_2SO_4 on mercury, and the two evidently react at all temperatures and concentrations;[1] but the reaction is very slow unless the acid is concentrated and the temperature is raised to about 300 degrees. Then the product carries with it sulphuric acid, which is difficult to remove.

Mercurous sulphate, on account of its slight solubility, can be readily prepared by precipitation from aqueous solutions. If we bring together solutions of mercurous nitrate and any sulphate, a white precipitate separates; and if the solutions are dilute and hot, and the one is added to the other slowly, the mercurous sulphate is beautifully crystalline. If this sulphate is washed with water, it turns yellow as soon as the acid has been washed out. Hydrolysis takes place and the resulting solid, according to Gouy (*Comptes Rendus*, 130, 1,399), is ($Hg_2OHg_2SO_4 H_2O$). This hydrolyzed product affects very markedly the electromotive force of the cell, as we shall show later, and its presence is to be avoided.

Gouy, in the paper referred to, finds that a concentration of one gramme molecule of H_2SO_4 in 1,000 litres of water (or N/500) does not hydrolyze mercurous sulphate. We have found that a much more dilute solution will not hydrolyze the salt. A concentration H_2SO_4 in 1,900 litres does not change the color of the salt at twenty-five degrees; while H_2SO_4 in 2,000 litres does produce a distinct yellow primrose tint. The higher the temperature the greater the concentration required to prevent hydrolysis. At ordinary room temperatures the salt may then be washed with H_2SO_4 in 2,000 litres. After the mother liquor has been removed by this washing, the process may be completed by washing five or six times with saturated cadmium sulphate solution, exhausting each time by a filter pump. This removes the last trace of acid, while the sulphate itself prevents hydrolysis. The last washing leaves the salt moist with saturated cadmium solution and ready to be made into a paste for setting up a cadmium cell. If the mercurous sulphate is to be used in a Clark cell, the final washings will be with concentrated zinc sulphate solution.

Since a small quantity of the salt will

[1] A paper read at the fifth general meeting of the American Electrochemical Society at Washington, D. C., April 7, 8 and 9, 1904. A preliminary account of an investigation carried out with the aid of a grant from the Elizabeth Thompson Science Fund. The authors desire to express their indebtedness to the trustees of this fund.

[1] Baskerville, *Journal* American Chemical Society, 19, 874.

make a number of cells, we wash in a Gooch crucible of some twenty-five cubic centimetres capacity with a tiny filter paper covering the perforated bottom. It is attached to a Bunsen filter flask and a filter pump. By this method the washing can be done in a few minutes. Only about three cubic centimetres of the cadmium sulphate or zinc sulphate solution are needed for each of the five or six washings.

Sunlight affects mercurous sulphate, turning it black if the exposure is long enough; and this black product gives in the cadmium cell a decidedly higher electromotive force than the white salt. So the mercurous sulphate which we have prepared by the different methods has been washed with $N/10H_2SO_4$ and has then been kept under the same acid solution in contact with mercury and in a dark room. With these precautions it appears to keep indefinitely.

In order to study the various preparations of mercurous sulphate from the point of view of their use as a depolarizer we have compared them with one, taken arbitrarily, as a standard. For this comparison we have used a large cell of H-form containing pure mercury in both legs and filled with $N/10H_2SO_4$. The mercury in one leg was covered with the reference mercurous sulphate, and in the other with the particular preparation to be tested. Preliminary experiments showed that when both legs contained the same preparation, the cell had no measurable electromotive force. The experimental concentration cell and a Weston cell were kept in a bath at twenty-five degrees, and the temperature did not vary more than 1/50 degree. The concentration cell was connected in series with the Weston, and a difference of electromotive force introduced by the concentration cell could easily be measured to 0.000005 volt.

It was easily shown that preparations of mercurous sulphate, made by well-known firms, when tested as above, differed by as much as one millivolt, and that our own preparations, made by different methods, did not agree. For example, the sample prepared by bringing together $HgNO_3$ — H_2SO_4 gave 0.143 millivolt higher electromotive force than the standard preparation; and that made from $HgNO_3$ — $CdSO_4$ gave 0.206 millivolt. In fact, it was found that there was a noticeable difference between two samples of mercurous sulphate made from the same reagents, the only difference in the preparation being that in one A was dropped into B, while in the other B was dropped into A.

These results suggested that perhaps Hg_2SO_4 might carry isomorphously a small quantity of $HgNo_3$, since both of these salts crystallize in similar forms in the monoclinic system, and there is evidence that mercurous nitrate is $Hg_2(NO_3)_2$ in solution. We have been able to detect the nitrate in commercial preparations and in some of those made by ourselves from $HgNO_3$. Tests made by means of the concentration cell show that a trace of $HgNo_3$ added to the standard preparation increases in a marked degree the electromotive force.

The following method has, therefore, been devised to secure Hg_2SO_4 free from the nitrate. We wished to use only mercury and sulphuric acid; to secure at the same time a sufficiently rapid reaction without the use of strong acid, we have employed an electric current. In a flat-bottomed beaker or deep crystallizing

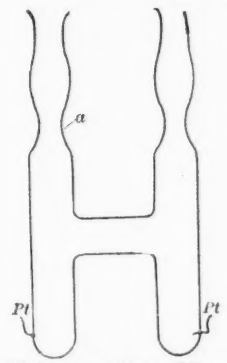


FIG. 1.—H-FORM OF CELL, READY TO BE FILLED.

dish is placed mercury a centimetre or so deep. This is covered with dilute sulphuric acid (one to six) to the depth of some ten centimetres. A platinum wire, protected, except at its end, by a glass tube, makes contact with the mercury, which serves as the anode; the cathode is a piece of sheet platinum in the H_2SO_4 solution. A current of about 0.3 ampere is passed from the mercury into the solution; crystalline mercurous sulphate at once begins to separate on the surface of the mercury. A stirrer, consisting of a glass rod, bent at right angles at the bottom, must be used to keep the mercury surface exposed. The foot of the stirrer passes close to the mercury and must be driven rapidly by a motor.

About 2.8 grammes an hour can be prepared in this way. The sulphate should be protected from the light. By means of a separatory funnel the excess of mercury may be readily removed from below, leaving the sulphate with more or less finely divided mercury mixed with it. The preparation is often somewhat gray on account of the presence of mercury in a state of fine division. This mercury is a distinct advantage, because it ensures the absence of the mercuric salt. This method, which is original with one of us and new, so far as we know, gives what we are strongly disposed to recommend as a standard preparation of mercurous sulphate. It gives a lower electromotive force with mercury than any preparation obtained from $HgNO_3$ and H_2SO_4 or a sulphate. Samples made at different times and with different materials show an exceedingly close agreement.

It may be inadvisable to add the precaution that the sulphate formed during the first few hours should be rejected unless one is sure of the purity of the mercury. After the electrolysis has proceeded for some time, the solubility of the mercurous sulphate is put in evidence by the appearance of mercury on the platinum cathode.

CONSTRUCTION OF THE CADMIUM CELL.

The H-form of cell is the most convenient to fill; and the method, introduced by one of us, of sealing the cell with small blast flames we have made so simple that the two legs may be hermetically sealed at the top without the least danger of affecting the contents of the element.

The glass parts can be readily made by any one possessing a little skill in glass-blowing. Fig. 1 shows the cell (half the actual size) ready to be filled. The tubing is drawn out and contracted at *a* so as to leave the diameter about six millimetres and with thin walls at this point. Fragments of the cadmium amalgam may be introduced into the clean dry cell, and may then be melted by dipping the leg of the cell into hot water; or the amalgam may be melted under cadmium sulphate solution, and may then be introduced in the liquid form by means of a small tube, slightly contracted at the end, and of a diameter that will allow it to pass freely through the neck *a*. This tube is used as a pipette; it permits the melted amalgam to be introduced rapidly and without splashing. The mercury, the thin paste and the concentrated cadmium sulphate solution may be introduced in the same manner. An alternative method is to introduce the materials through little funnels made out of small test tubes. The funnels must pass through the neck *a* of the cell and must reach well down toward the bottom.

The electrolytic mercurous sulphate, which has stood with mercury under dilute sulphuric acid, is brought into a Gooch crucible, avoiding free mercury, which interferes with the filtering; it is then

washed first with sulphuric acid (made by adding 0.5 cubic centimetre concentrated H_2SO_4, density 1.84 to a litre of water), and then with concentrated cadmium sulphate solution, as described above. It is better to reject the top layer, which may be slightly darkened. The paste is next made in a clean agate mortar by grinding together crystals of $CdSO_4$ $8/3H_2O$, and a little mercury, and then mixing in about three volumes of the mercurous sulphate and enough saturated cadmium sulphate solution to make a thin paste. After the mercury and the paste have been introduced into the positive side of the cell, both legs are filled up to the cross tube with the dry clean crystals of $CdSO_4 8/3H_2O$. Enough of the saturated cadmium sulphate solution is finally added to fill the cell to the top of the cross tube. The sealing-off is readily done by means of two small horizontal blast flames, three centimetres long, directed in a line toward each other and just meeting. The narrow part *a* of the cell is brought between the impinging flames, the glass quickly softens, and the top part is drawn off. There is no noticeable heating of the contents of the cell; but it may be advisable, before one has acquired the proper skill, to protect the cell by an asbestos disc fitted to the tube below the point *a*. The disc is not necessary if the cell is made like the one shown in Fig. 1. A cell sealed in this way contains nothing except the materials of the voltaic combination. It can not leak and can be immersed in kerosene without danger of the oil getting inside. A perfect seal has always been a most difficult thing to secure.

All the cells above tabulated were filled and sealed as described. The dates on which they were set up are contained in the second column; they are numbered in groups of ten, because they are mounted in racks holding ten cells each for convenience in placing them in a large sixty-litre kerosene oil bath. The temperature of the bath was automatically regulated and the oil was thoroughly stirred by a motor-driven stirrer; the variation of temperature was not more than one-tenth of a degree at any time.

Date		Jan. 6, 1904	Jan. 8, 1904	Jan. 11, 1904	Jan. 19, 1904	Feb. 1, 1904	Feb 15, 1904	Feb. 16, 1904	Feb. 17, 1904	Feb. 18, 1904	Feb. 20, 1904	Feb. 22, 1904	Feb. 24, 1904	Feb. 25 1904	Feb. 27 1904
Temp.		21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.1°	21.2°	21.1°	21.0°	21.0°
B 1	Jan. 28, '03	1.01936$_0$	1.01935+	1.01937	1.01936	1.01936$_4$	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	1.01936$_0$
B 2	Mar 9, "	29	27	26	28	27	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	27$_0$
B 3	" " "	31	30	30$_0$	31	29$_6$	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	31
B 4	" " "	29	28	28	29	28	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	28
B 5	" " "	31	30	30	30	30	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	29$_6$
B 6	June 22, "	36	35$_0$	34	35	35	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	36$_0$
B 7	" " "	36	36	36	36	36	1.01936	1.01936	1.01936	1.01936	1.01936	1.01936	1.01936	1 01936	1.01936
B 8	" " "	35$_0$	36	35	35	35	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	36$_0$
B 9	" " "	33	34	33	33$_0$	33	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	33
B10	" " "	35	35$_0$	35	35	35$_0$	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	36
D 1	Dec. 21, "	08	07	06+	06	06$_2$	07$_0$	07	07	07	. . . .	07	. . . .	07	07
D 2	" " "	09	07+	07	06$_8$	06$_0$	08	07	08	08	. . . .	08+	. . . .	08+	08
D 3	" " "	09	08	07	07	07	08	08	08	08	. . . .	09	. . . .	08$_6$	08
D 4	" " "	09	08	08	07+	07$_0$	09	08	08+	08+	. . . .	09	. . . .	09	08
D 5	" 24, "	83$_0$	50	44	37$_0$	35	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	31
D 6	" " "	84	48	42	36	33+	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	29
D 7	" " "	54	45	41	36	34	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	30
D 8	" " "	58$_0$	46	42	35	31	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	27
D 9	" " "	91	49	44	37	33	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	29
D10	" " "	68	53	47	39	34	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	29
F 1	Feb. 15, '04	. .	. .	. .	. .	. .	07	06$_9$	07	07	07	07$_0$	08	08	07$_0$
F 2	" " "	. .	. .	. .	. .	. .	07	06	07	07	07+	08	08+	08	07$_2$
F 3	" " "	. .	. .	. .	. .	. .	07	07	07	07	07$_2$	08	08+	08	07$_4$
F 4	" " "	. .	. .	. .	. .	. .	08	08	07+	07	08	08	08	08	07$_6$
F 5	" " "	. .	. .	. .	. .	. .	08	07	07	06	08	08	08$_2$	08$_2$	08
F 6	" " "	. .	. .	. .	. .	. .	06$_9$	06	07	07	08	08	09	08$_2$	08
F 7	" " "	. .	. .	. .	. .	. .	07	06	07$_0$	07	07$_0$	08	08	08	08+
F 8	" " "	. .	. .	. .	. .	. .	08	07	07$_0$	07$_0$	07	08	08+	08	08
F 9	" " "	. .	. .	. .	. .	. .	08	07	07	07	08	08	09	09	08$_4$
F10	" " "	. .	. .	. .	. .	. .	07	06$_9$	07	07	07$_0$	08	08	08	08+
G 1	Feb. 15, '04						21$_4$	18	18$_0$	17	17	17	17—	16$_0$	15$_0$
G 2	" " "						1.02022	1.02000	98	92	92	97	87—	89	83
G 3	" " "						1915	1911	11	12$_0$	12	11	12—	12	11$_0$
G 4	" 26, "						. . . .	. . . .	. . . .	. . . .	1.02028	1.02018	1.02002	1.02001	98
G 5	" " "						. . . .	. . . .	. . . .	. . . .	26	14	10	1.8+	1.0 0 5+
G 6	" " "						. . . .	. . . .	. . . .	. . . .	31	21	12	03	11

TABLE OF RESULTS FOR CADMIUM CELLS.

It remained practically constant for days at a time.

The cells were compared by means of a Feussner direct-reading potentiometer, made by Otto Wolff, of Berlin. The comparisons can be made rapidly and with certainty to the fifth decimal place.

It will be noticed that B1 to B10 are relatively old cells that had settled down to a constant value; thew were assumed not to vary more than 0.00001 volt when kept at a fixed temperature. B7 was taken each time for setting the potentiometer at 1.01936, which is the electromotive force obtained for the cadmium cell at 21.1 degrees by assuming the Clark at fifteen degrees as 1.434 international volts, and the ratio of Clark at fifteen degrees to cadmium at twenty degrees as 1.40670.[1] These cells, B1 to B10, were set up in accordance with the most approved information available at the time, and they must agree closely with the cells used for determining the Clark fifteen degrees cadmium twenty degrees ratio of 1.40670.

D1 to D4 were the first cells made in which the electrolytic mercurous sulphate was used. They were put up December 22, 1903; and, while they were not put into the constant temperature bath till January 5, 1904, they showed from the first a large and constant difference from B7. Previous to January 6 their value relative to B7 had not changed perceptibly; the table shows their behavior since January 6. These cells do not appear to have changed since they were set up by more than one part in a 100,000, and the agreement among themselves is exceptionally good. Their electromotive force is about twenty-eight parts in 100,000 lower than B6 to B10.

The next series made with the electrolytic mercurous sulphate was set up February 15, 1904. The materials used were different from those used in the construction of D1 to D4, but they were prepared as already described. The cells composing the F series were put into the bath and compared within six hours after they were set up. The table shows their history for the first twelve days. The very small variations which they exhibit may be more apparent than real, because they may be due in part, at least, to small variations in the reference cell B7.

It will be noticed that the cells of this F series are identical with D1 to D4, and that their apparent electromotive force is 1.01908 international volts at 21.1 volts.

Cells D5 to D10 were made with mercurous sulphate prepared by adding a solution of mercurous nitrate to a cadmium sulphate solution; it was the same sample which gave in our test cell an electromotive force 0.206 millivolt greater than the standard electrolytic preparation.

When these cells were first compared, immediately after setting up, they were

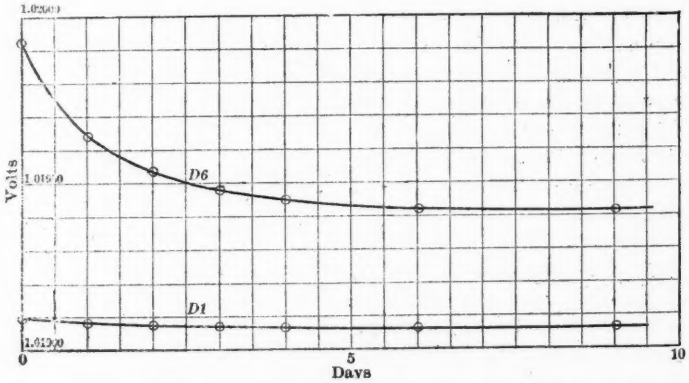


FIG. 2.—CURVES SHOWING THE BEHAVIOR OF CELLS ON TEST.

[1] Zeitschrift für Instrumentenkunde, February, 1901.

markedly higher than B7, but their electromotive force fell rather rapidly at first, and very uniformly after they were placed in the constant temperature bath. The table shows their history from January 6; the upper curve in Fig. 2 was plotted from the data pertaining to D6 from January 5 for the first nine days after its temperature was maintained constant. The contrast between the behavior of this cell and that of D1, which is shown graphically in the lower curve of Fig. 2, is very marked and verv characteristic. Professors Jaeger and Lindeck called attention some time ago to the rapid fall in electromotive force shown by some cadmium cells set up with mercurous sulphate obtained from one, at least, of the best manufacturers.[1] We consider it an accomplishment of considerable value and interest to be able to make cells that do not require the aging process to reach their equilibrium in electromotive force. The electrolytic method of preparation furnishes us with a mercurous sulphate absolutely free from any nitrate, and with cells that reach their equilibrium immediately. This fact, together with the lower value of the electromotive force, compared with that of cells made by the use of mercurous sulphate prepared in any other way, points to the purity of the electrolytic salt, compared especially with that made from the nitrate of mercury.

The cell marked G1 was set up with electrolytic sulphate of mercury, to which a trace of mercurous nitrate was added and mechanically mixed in the paste. G1 shows both the time element and the higher electromotive force.

Cell G2 was made with mercurous sulphate which had been exposed to sunlight for six weeks (under $N/10H_2SO_4$) and which was quite black. The cell has a very high electromotive force, showing that the salt discolored by sunlight has undergone a marked change and needs further investigation. After a cell has been set up the discoloration produced by the light is probably only superficial and may not affect the electromotive force seriously; but it is better to avoid the discoloration by excluding the light from the cell.

The mercurous salt used in G3 was made from recrystallized mercuric sulphate ($HgSO_4$), which was shaken with mercury in dilute sulphuric acid. The reduction is brought about by vigorous shaking so as to ensure the fine division of the mercury and its distribution throughout the salt. The electromotive force of this cell is very close to those made with the electrolytic sulphate; the slight time element indicates a slight impurity. This experience indicates also that the high electromotive force of other cells is not due to the presence of the mercuric salt.

Cells G4, G5 and G6 were made with mercurous sulphate which had been hydrolyzed by shaking with water and mercury, renewing the water six times, or until the conductivity of the solution was constant, showing that no further change was taking place. These cells have also a high electromotive force, and the mercurous sulphate modified in this way presents another problem to be worked out. Indeed, this preliminary work has opened up a large field for chemical investigation, which we hope to report on later.

This paper deals with cadmium cells only. We shall proceed immediately to apply the same methods and preparations to the Clark cell.

[1] Zeitschrift für Instrumentenkunde, February, 1901.

News from Mexico.

[*From Our Special Correspondent.*]

The famous El Oro mining camp will be supplied with power from the great electric plant at Necaxa, which is now in course of construction by the Mexican Light and Power Company, of Mexico City. The current supplied by the power company will be of high tensity, having a voltage of 6,000, but the plan adopted will be to have rotary transformers at suitable locations. The change from steam to electric power at the mining camp will involve heavy purchases of electrical supplies. Address El Oro Mining and Railroad Company, El Oro, Mexico.

The Mexico City railroad company, which operates an excellent electric street car system, is now negotiating with the Mexican Light and Power Company for the purpose of purchasing power, in which event the immense steam plant of the company will be discontinued. Address W. W. Wheatley, general manager of the Compania Limitada de Transvias Electricos de Mexico, So. Mexico City.

Electric light will be initiated in the town of Tapatitlan in the state of Sonora. Address the jafe politico (the mayor).

An electric light plant will be constructed in the town of San Miguel, state of Jalisco. Exemption from all municipal and state taxes has been granted the company which will undertake the installation. Address the jafe politico.

The Batavia Plantation Company, of Oaxaca, with head office in Milwaukee, Wis., president, C. E. Lyman, will install an electric plant on its property for traction and illumination purposes.

An electric light plant is needed in San Luis Potosí, the capital of the state of that name. The governor has called for bids. Address Governor Ingeniero Don Blas Escontria, San Luis Potosí, Mexico.

J. B.

City of Mexico, April 2.

Death of Mr. Thomas J. Wilmot.

Mr. Thomas J. Wilmot, superintendent of the Commercial Cable Company's station at Waterville, Ireland, after an illness of some three weeks, died on April 12. Born in London in September, 1851, Mr. Wilmot began his telegraphic service with the Electric and International Telegraph Company in 1866. He soon attracted the attention of Sir William H. Preece by his abilities, and this eminent engineer manifested a great deal of interest in the young man. He entered the service of the Direct United States Cable Company in 1874, and in 1884 he became associated with the Commercial Cable Company, in the same year being appointed superintendent of the Boston office of the latter company. He was appointed superintendent of the Commercial Cable Company's main cable station at Waterville, Ireland, in 1885, and he held this position for nineteen years with credit to himself and the company.

Mr. Wilmot was very well known in cable circles, and was an inventor of considerable note. He perfected a system of repeating between submarine cables and land lines, but his most notable achievement was in the application of an automatic transmitter to long submarine cables. The perfection of this latter system was reached only after the most painstaking and long-enduring research and experimentation, and it has resulted in producing a thoroughly practical instrument which improves the signals and increases the speed.

Mr. Wilmot was a member of the Institution of Electrical Engineers, the London Society of Arts, the American Association for the Advancement of Science, and several other societies. That he was held in high esteem by members in all branches of the service is evidenced by the numerous messages of sympathy which have been received by his family. The following message, which has been sent to every office of the Commercial Cable Company's system, evidences the esteem in which he was held by the executive department:

"From the general manager to all Commercial Cable Company stations: Mr. Wilmot, superintendent of Waterville since 1885, is dead. The company has lost a most faithful and efficient servant, and every other loyal servant of the company has lost a loyal colleague and warm-hearted friend. His body is to be interred at Waterville at noon, Greenwich time, on Friday. As a mark of respect to his memory, please suspend all circuits on Friday from noon, Greenwich time, until five minutes after."

TELEGRAPHY IN CIBIRIA.

THE WAR MAKES IT OF MORE THAN PASSING INTEREST.

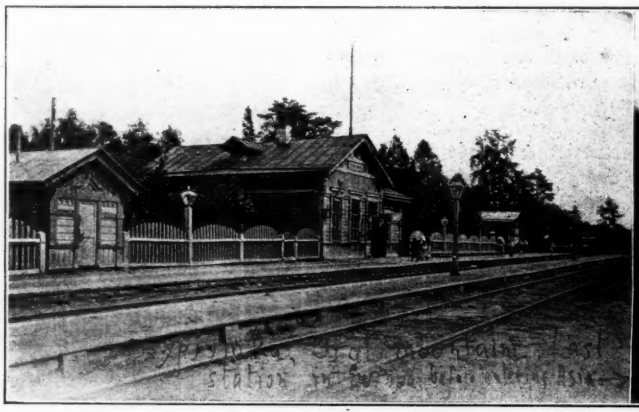
BY L. LODIAN.

There are no separate statistical telegraph tables concerning Cibiria issued by the Russian postal administration; they are all included under the one official head of "Pocia." Russia (including the Asiatic dominion) possesses, approximately, 100,000 miles of lines, which represent some 300,000 miles of actual wiring done. Some 20,000,000 messages are sent annually, which, to a population of 130,000,000, represents but 0.14 of a message per capita. Only a few other countries of the globe occupy a lower rating: Persia, 0.08; India, 0.03; Brazil, 0.02. Compare this with thrifty France, which is one and one-quarter messages per head (eclipsing even the United States, with 1.08); Britain, with 2.15; the Australian republic, with 2.40, and New-Zealand, with the maximum, 5.05. (New-sy Zealand!)

Credit due to United States Bureau of Statistics for preceding excerpts.

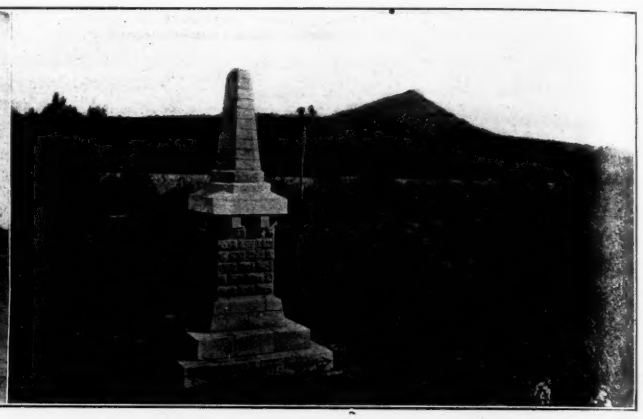
If there is any body of telegraphers in the world having—to use a studiedly-moderate expression—a trying time just now, it is those Cibirian *telerpaфiçts* who are receiving and transmitting the war despatches to and from Peterburg. The Russian war-office does not use the word-code for its more important messages; it is all cypher, and a tremendous strain on the employés who, sweatingly conscious of the sort that awaits them if a serious military despatch error should be billed against them, are just now undergoing the mental strain of their lives. For it is easy to imagine the difference between transmitting code words and cyphers. For instance: "lazytchik." ("We make a frontal feint, and then concentrate on the enemy's flank at noon to-day") is easy to transmit, being a regular Russian word; but "7645," followed by scores of other groups of figures, is uninteresting and trying to a degree.

There are two lines from Port-Arthur to the Baikal, then three to Ipkytçk (Irkutsk), four to Omçk and six to the Urals, and (then merging with the Russian lines proper) eight to a dozen to the capital Peterburg.



D. Efimof, Print, Moçkba.

THE LAST STATION IN EUROPE—YPJYMKA.



Chepep-Habrolz, Print, Moçkba.

THE HISTORIC ASIA-EUROPA MONUMENT ON THE URAL MESA, OR PLATEAU. ON ONE SIDE IS GRAVED (IN RUSSIAN) AZIA; ON THE OTHER, EBPONA (EUROPA.)

Installed originally by Danish capital, with Skandinavian operators thro'out, the trans-Cibirian telegraph has since a dozen years reverted entirely to the Russian state, and not even a single of the old employés is left.

The method of wiring, offers no difference to our own trans-American lines; but occasionally, instead of putting up verstage or mile-posts to denote distances, the authorities have hit upon the simple plan of nailing verstage-boards to the poles (so many poles going to the versta); and, in villages, the poles are utilized for receiving the statistical boards which are a peculiarity of Cibirian communal civics. On one will be painted, for instance, as follows (in Russian, of course, but I give the translation), and placed on the pole outside the postal telegraph office:

This is the village of
CIPOÇTAH
First settled—May 1763
Number of men.....283
Number of women.....313
total 596
Number of houses.....118
Date of this census: 17-18 April, 1897

The census is taken 5-yearly, and is of all people in the houses of, say, the night of the 17-18 April. Still another use to make of the telegraph poles, outside the village commune house, is to affix thereto the long-distance verstage-board with the indicating hand, thus

☚ To Peterburg 6,471 miles.

(In Russia, it is 9,877 verstas).

The Hughes, Morse and Wheatstone instruments are used thro'out Cibiria, and occasionally you see the Foy-Bréquet (Paris) mechanism. All employés wear uniforms, and are graded accorded to *chins* (ranks). Their pay comes out about 60 pybli (rubli) monthly, but it won't purchase what $30 will in America; so the slaf telegrapher is about the worst paid in the world (unless we except the Turk or Español—who doesn't get paid at all unless he goes on strike). He has to find his own uniform, house, fuel and wife; is hospitable, but not reliable. Is not a Christian; calls himself a *npabo-çlabni*, —meaning "right-thinker." They used to ask me my religion—"kak bacha bepa?" I would reply, slightly rimingly, "stakan chii-ia" (meaning, "cup of tea"), and, as a slaf will overlook a lot for a bon-mot, that settled the "religious problem," the hint was taken, and in a few minutes his *jena* (wife) would bring in the steaming samobar.

Life among the long-distance line-repair men in eastern and central Cibiria has many harsh and many pleasant features. Having frequently, during travels, come across their isolated equipments in the *ciepa* or table-land elevations of the Iabloni and Altai ranges, and been pressed to put up with them—(such is human nature's craving for a little society)—I have many happy reminiscences of the outdoor

Tomachkebich. Ne ative, Kpaçnoiapçk.

System Arc Street-Lighting and Telegraphs at Tomçk—Clinical University Building.

life of those who maintain in repair the overland Cibirian telegraph lines.

The little repair companies consist of six or eight men, including the leader (*natchalnik*). They leave the far-away town—where they have been wintering—about the middle of April. Winter, the lines are left to shift for themselves pretty much. The climatic conditions are too severe to send parties out, and it is only a very serious or total break which warrants the administration despatching trouble-men to the scene—and then only in parties of two, who hastily make merely the most urgent temporary or makeshift renewals, and beat a speedy retreat. I will leave the leader to imagine repairing "up aloft" in—40 below zero, amid the howling icy-blasts of the Cibirian subarctic zone. Also have I come across these solitary mid-winter repair-men in the heart of western Cibiria. There they were, half-perished, working in—52 below zero centigrade (= —62 fahr.), almost frozen, despite their cumbrous and weighty fur-skin overcoats, which seriously impede their movements. Some of these coats weigh a quarter-hundredweight (25-30 lbs.).

Then, to ameliorate conditions somewhat, they build wood-fires about the site where they are working. This temporizes appreciably the tenor of those arctic tornados of the great *cten* (pronounced çtep) region. To give you an idea of the "searching" character of those Cibirian sizzing mid-winter blasts, I will state that it will penetrate here and there the dozen eyelet-holes of the laced-up boots, and "nip" with frost-bites the thick wool-encased instep.

But in summer, "the order changeth," and we get a few months of piping-hot, torrid weather. May and June are the evenest-tempered months. The repair parties are sent out with their horses and wagons, with tent and provisions; and they also count upon some sport to secure game. They will have, say, 600 verstas of line to cover, and will be at it all summer. There is a controlling telegraph engineer, who is over all the different parties, and makes one single round trip to look after the work. He is called, in the vernacular, *kontpolep-telerpafiçt*. His pay is only 1,000 rubli yearly; so, to make ends meet, he—like our own congressmen—goes "on the make."

For mounting the poles, the repairers use the clumsy contrivance which evidently they have borrowed from the French—a couple of iron jaws with teeth, weighing about five pounds apiece, or, say, twenty pounds for the entire set of four "jaws." These have, I believe, never been seen in this country. Compare them to the three or four-pound-weighing light and strong steel thigh-hooks dissimulated under the American country trouble-man's trouser-leg, and you will have no two opinions of the best. Imagine one of the steel-grip hooks you may see being used to lug ice into the shops of Manhattan, and the insides of that hook jawed with teeth, and you will have a good idea of the Cibirian article. This is strapped to the boot and leg, and the pressure in ascending causes the teeth to "bite" almost all round into the pole. It is pretty safe, true, but grotesquely ugly and inconvenient, because the lineman

H. Pen, Phot., Tomçk.

The Nochtamtckaia-ylitça (Post Office Street), Tomçk.

Akcelpod, Print, Kpaçnoiapçk.

A Vivid View of Track-Laying on the Trans-Cibirian.

can not walk in them even the short distance from pole to pole, but must remove them on each shift, and go thro that re-strapping process twenty or thirty times a day.

But in India I noticed the method was still simpler. Those lithe Hindu repair-men simply walked up the poles like athletes or monkeys. Planting the palms of the feet against the pole, they have only to clap their hands against the same to go up more easily than many people mount a single flight of stairs. While stopping up aloft, they either fasten their engirdling back-strap to the pole, and throw their whole weight back on the strap (in retaining their all-essential foot-cling on the pole), and thus have both hands free to work with, or they simply throw one limb astride the cross-trees, and perch thereon till the work is finished.

Taking all things very easy, the Cibirian repair-men are thro with the day's work by 4 p.m.—by which time one of the men has prepared the dinner for all. Next follows the tea-drinking, sometimes coffee, sweetmeats, cigarettes, and then each man has a few hours for himself. They turn in by nine, and the first man is up by three to prepare the coffee. By four all are about, and the sun in those latitudes is well up also, beaming from mountain to mountain. Those early morn-

Anrepep-Gochl, Print, Bien, Abçtpia

INTERIOR, TRAVELING CHURCH-CAR, TRANS-CIBIRIAN RAILROAD.

ings are dry, cool and clear, with a rising breeze, and the beautiful panorama and mesa foliage on every hand is charmed with all the poetry and imagery of distant prospects and vast horizons.

Such the summer life and surroundings of the Cibirian repair-kits in the far, far north-east.

The chief inland telegraphic exchanges are those at Omçk and Ipkytçk (Irkutsk). Here the squads work in shifts of twenty-four hours, then forty-eight off. It is not to be supposed, however, that they work those twenty-four hours right off. They are simply at the station from noon of one day to noon the next, and always have opportunity of both "miking" (idling) and napping.

The chiefs of these *bypos* (official exchanges) receive about 150 pybli monthly; and the telephone installations now current thro-out Cibiria come also under their ken.

Even in peace times, I found by actual experience, the Cibirian telegraph is unsatisfactory. Thus, wiring from the Ural mountains back to the Russian Pacific coast (passport trouble), it took nine days to get a prepaid official reply. An express train could have carried the message there and back in ten days. There are two rates —simple and express. If you pay express or double rates, your message takes precedence over ordinary telegrams, but is still preceded (and maybe held up for days) by official routine despatches of mostly no consequence. On the great 5,000-mile karavan route, it frequently happened that an ordinary despatch sent in the morning to the next station, thirty verstas ahead, to announce my arrival (after going over the work) that evening, never turned up till two or three days later —the wires being surcharged by their official use.

We read in the papers of the "prodigious" use in the east of the wireless system by a certain London daily, occasionally some "fifteen hundred" words being reported by wireless in one day from a news-gathering tug—received at a Chinese port, and reforwarded by cable to Europe, "thus escaping the Russian and Japanese censors." Rather too prodigious! It is possibly true that some fifteen words are "caught on to" or half-imagined by the "enterprising" correspondent on the China mainland; but my own personal knowledge of the regions, and of both warring parties, enables me to readily discern nearly fifteen hundred words of inventive "padding" and manufacture in those essentially "wireless" messages. Of course the London daily is stranger to this manufacture (of course!). But there—our own American "journals" and *"worlds"* can always "beat the world"—(and do do so every day)—by purely "wireless" messages—which they are too modest to announce as such, from "the ends of the earth," and particularly just now from the extreme orient.

The American Electrochemical Society.

Fifth General Meeting, Held at Washington, D. C., April 7, 8 and 9.

THE fifth general meeting of the American Electrochemical Society was held at Washington, D. C., Thursday, Friday and Saturday of last week. A meeting of the board of directors took place at 9 A. M. on Thursday, the general meeting opening at ten o'clock, when the society was welcomed to Washington by Dr. Charles W. Needham, president of the Columbian University, who had courteously offered the use of a hall for the meetings.

The secretary, Mr. C. J. Reed, presented his report. This dealt principally with the membership of the society and the printing and distribution of transactions. One hundred and eighty-six new members were elected during the year. A number have resigned or been dropped during the past year and the total membership is now something over 600.

The report of the treasurer, Dr. P. G. Salom, was read by the secretary, and showed that the cash balance in the treasury on March 31, 1904, was $3,737.07. The value of the copies of the transactions on hand is about $3,000, making the total assets of the society approximately $7,000.

A motion by Mr. Carl Hering, that the reports of officers be printed in advance and distributed at the meetings, was adopted.

President Richards announced that the Frenzel prize, which is offered for the best paper upon an electrolytic method of refining precious ores, had not been called for and the offer is still open.

The proposed amendment to the constitution, which makes the president, vice-presidents and managers ineligible for immediate reelection at the expiration of the full term of office, was adopted.

A motion that three delegates to the International Electrical Congress be appointed by the directors was also adopted. These delegates will represent the society officially at the congress, and will read papers prepared for that occasion. Other papers will be read by members of the society at the joint meeting of the electrochemical section of the congress and the society. The number of papers to be presented at this joint meeting has been limited to 150, and the list is already nearly completed.

There being no other business matters to come before the society, the reading and discussion of papers were taken up. The first paper was by Dr. F. A. Wolff, of the Bureau of Standards, Washington. This is entitled "Standard Cells." Dr. Wolff gave an historical sketch of legislation affecting standard cells. Comparatively few countries have taken any action, though such action as has been taken has been in reference to the Clark cell. The author dwelt upon the importance of properly defining the standards of current, voltage and resistance, but thought it would be advisable to limit legislation to two of these—voltage and resistance. These being accurately defined, the unit of current follows from Ohm's law, and there is no disagreement due to a third definition. The standard of electromotive force, rather than the standard of current, was advised, because of the greater ease of measuring electromotive forces by means of the potentiometer. The accuracy of reproduction of the standard cell is, at the present, greater than the commercial demand. The time required to make a comparison is short, and by the use of the potentiometer accurate current measurements are possible. On the other hand, if a unit of current should be adopted, uncertainty in the results of the silver voltameter is always involved, and the work itself is tedious and delicate.

Dr. Wolff then made a comparison of the Clark and Weston cells. The constancy of the two is about equal. The Clark cell has a higher electromotive force, which may be determined more accurately. The Weston cell has a temperature coefficient about one-thirtieth that of the Clark cell. The hysteresis or lag of voltage behind changes in temperature is, for this reason, less, this being a serious difficulty in the use of the Clark cell. The mortality of the Weston cell is much less than that of the Clark cell, and no layer of gas is formed at the mercury in this cell. He believes the Weston cell is certain to displace the Clark cell.

The points to be covered in preparing specifications for the Weston cell were then considered. Double-distilled mercury is good, or it may be prepared electrolytically. Zinc may be prepared by electrolysis, the resulting powder being sublimated in order to remove the platinum. Zinc prepared in this way should contain less than one part in one hundred thousand of impurities. Cadmium is also easily prepared by electrolysis. Zinc sulphate should be prepared from pure zinc and pure sulphuric acid. A detailed account was given of an electrolytic method for preparing pure mercurous sulphate. Two glass vessels are taken, one small enough to be placed within the other, and in each of these is placed a layer of pure mercury. The two vessels are then filled to a point above the edge of the inner vessel with pure sulphuric acid. Contact is made by means of glass tubes filled with mercury. A stirrer, formed of a glass rod driven by a small motor, is made to agitate the surface of the mercury in the inner vessel, this forming the anode of the cell. The inner vessel is covered by glass, and the whole apparatus protected by a shield placed above. Current is passed through, and the mercurous sulphate forms in large regular crystals. This method is practically the same as that devised by Dr. Henry S. Carhart, and described by him in a paper read at the same meeting. Dr. Wolff stated that the saturated Weston cell was the only one to be considered for a standard, although the unsaturated one would be useful for commercial purposes. He had watched three unsaturated cells for over a year, and found a variation of only three parts in one hundred thousand in that time.

The paper by Dr. Henry S. Carhart and Dr. George A. Hulett, entitled "Preparation of Materials for Standard Cells and Their Construction," was read. This appears in full on another page of this issue. It describes methods of preparing materials and of constructing Weston cells, and gives results of many measurements upon cells made by the authors. These results show remarkable constancy, both in individual cells and in the accuracy with which they can be reproduced, the variation seldom amounting to more than one part in one hundred thousand.

In the discussion, Mr. Henry Noel Potter asked whether any effect should be expected from the kind of glass used for the retaining-vessel. The glass varies considerably, and it is possible that the greatest difference in the cells made in different countries would be found to be due to this. This factor has not yet been studied.

In reply to an enquiry by Dr. Richards, as to the means of determining the temperature of the cells, it was explained that a sensitive mercury thermometer was entirely satisfactory, since the temperature had but little effect upon the voltage of the cell.

To the query of Mr. Carl Hering, as to the effect upon the voltage of the cells caused by the difference of pressure, it

was thought by Dr. Carhart that the good agreement between different cells, as indicated by the tables which accompanied this paper, showed that no difficulty need be anticipated on this account. He thought that the effects which had been observed previously were caused by a difference in pressure between the two legs of the cell, while he had adopted the H-type of cell. Moreover, the glass vessels are soft and should yield to changes in pressure. Dr. Carhart made the point, that the standard or saturated cell should be called the Weston cell, in order that its inventor might receive full credit. This is to distinguish it from the commercial or unsaturated type, which, at the present time, is often known as the Weston cell.

A paper was read by Mr. William Roy Mott, on "Single Potentials of the Halogen Elements." There are a number of points in the ionization theory not in harmony with some points observed in the study of single potentials, and the impossible solution tensions which have been assigned to metals tend to blind one to the fact that the actual chemical reaction taking place and its free, unbound energy are the essential points. The author has calculated the single potentials of the halogen salts of metals, and presented his results in tabular form and in curves, showing the results plotted, with the decomposition volts calculated for dilute aqueous solution as ordinates, and the corresponding single potentials as abscissa.

Dr. Rudolf Gahl, in discussing the paper, thought that the application of Nernst's formula would have been more useful, as this is in complete accord with the thermodynamics of solution.

On Thursday evening the society assembled at the Columbian University to hear the presidential address. For the purpose of his discussion, Dr. Richards divided electrochemistry into three classes, and pointed out how progress might be made in each class so as to advance the entire art. The first division related to the investigation and classification of electrochemical phenomena. Reference was made to the most valuable literature on this subject, and it was shown that, although a great deal of work had been done, there were large gaps, due to the lack of cooperation. The society, by bringing its members in contact and familiarizing each with the work of the others, should show where gaps exist, and thus help to fill them. It was pointed out that the experimental data upon the conduct of fused salts is imperfect. Calorimetric investigations should be made, and a study of the deposition of alloys or mixtures of metals—in fact, no other field offers so many opportunities for original work. The second division of the subject should be the building of a comprehensive electrochemical theory. The speaker thought that at the present time we are merely groping in the dark. We can not say that the theory of disassociation is not true, but he thought it very certain that those who say it certainly is true are making a mistake. He explained his own conception, which is that substances in solution are in an abnormal physical state, sometimes with combination. This state has many resemblances to the gaseous state. He said that the electron theory of matter propounded by Dr. J. J. Thomson would be adopted for electrochemistry if adopted by the physicist.

The third division of the address considered the applications of electrochemistry to industrial needs. This is important, since practical use adds much interest to the theoretical investigations. The application of electricity to producing materials has brought a powerful new weapon to the aid of man, and many processes heretofore impractical, and others unthought of, are now employed commercially. As an illustration, he mentioned that commercial silicon is now considered a rare metal, and commands a correspondingly high price in the market, while it is being made in quantity at Niagara Falls by Mr. F. J. Tone, who is now wondering whether anybody would like to purchase it by the ton. He pointed out that the proper limitations of electrochemical processes should be recognized. Thus, electrolytic production of iron is at present far from possible, even in the most advantageously situated countries, but the higher priced product, steel, is already being prepared commercially by electrolysis. As electrical energy is expensive, it should be used only where it acts to the greatest advantage. Thus, in the electric furnace, heating by other means should be adopted at all parts of the process where nothing would be gained by using electricity, the latter being used only in raising the material to the tapping heat. A number of metals now comparatively rare and difficult to obtain can be prepared electrochemically, and should become of considerable importance. One of these is calcium, which is abundant everywhere and costs nothing except to produce it. It is a powerful pyro-chemical. Other of these materials which are valuable are magnesium and berryllium. The value of electrochemical processes for refining metals was sketched briefly, as well as methods of preparing compounds, and other industrial uses of electrical energy.

The first paper read on Friday was by President Richards, on "The Composition and Resolution of Voltages." The author considered the electrolysis of mixtures of metals, and the energy required for depositing alloys. In refining a metal—for instance, copper—more metals go into solution than are deposited. Assuming, then, a constant process in which the electrolyte does not change, there is more energy developed by the dissolution of the anode than by the deposition on the cathode. In other words, refining a metal should actually give an electromotive force. The case of copper ninety-two per cent pure was considered, and, knowing the kind and amount of impurities, the amount of energy set free in dissolving was calculated. This, when divided by the useful current, was shown to correspond to 0.065 volt. By applying this method to any mixture, the actual voltage required, either to refine a metal or to deposit an alloy, should be computed easily.

In the discussion of this paper, Mr. William R. Mott thought that the effects of the change in concentration of the overvoltage of hydrogen had not been considered.

Mr. Carl Hering thought that the method was based upon theoretical considerations of the law of the conservation of energy, and he did not think that practice had shown that the results deduced were correct. It was hard to believe, for example, that a lower electromotive force would be required to deposit zinc from an alloy than would be needed for the zinc alone. He thought that this excess energy—in the case of zinc, at least—would be evolved at heat at the anode, due to local action, and that the excess voltage, if it existed, would be small and masked by other effects, such as resistance. He questioned the value of the process, on account of the greater influence of other factors which had not been considered.

Dr. Rudolf Gahl criticised Dr. Richards's method of computing the voltage, as it would indicate a straight-line law for the variation in voltage in depositing alloys of zinc and copper, varying from all copper to all zinc. The osmotic theory had not been considered by Dr. Richards, and this theory indicated that the curve for electromotive force required to deposit an alloy of copper and zinc rises very rapidly from pure copper to an alloy containing a few per cent of zinc, and

then is nearly horizontal until zinc alone is deposited.

Mr. C. J. Reed differed from Dr. Gahl on this point. His experience has shown that the law of variation is practically a straight line; and Mr. Lawrence Addicks added, that in refining metals, particularly copper, the impurities may be thrown down without an appreciable increase in the depositing voltage. Dr. Gahl said that his example was for a simple case only, and, in practice, neither law would be right.

Replying to the discussion, Dr. Richards explained that he assumed a condition of equilibrium, and that the energy of solution of the impurities must necessarily be added to the current. His calculations had not taken into consideration local action. He believed that the greater part of the impurities was dissolved by the current. Although the excessive electromotive force of copper is small and may be obscured, this should not be the case with nickel, where it amounts to 0.47 volt. Over-voltages had not been considered.

Mr. C. J. Reed read a paper entitled "Molecular Conductivity," in which he criticised the loose use of terms by electrochemists. His argument was based principally upon the so-called "molecular conductivity," a quantity which he held did not exist. He quoted from the works of a number of well-known authors to show that, in each case, the term "conductance" should have been used.

This paper provoked considerable discussion between those who see some value in the theory of dissociation and those who do not. A long reply was made to Mr. Reed by Dr. E. F. Roeber, who deduced an algebraic expression to show that the term "molecular conductivity" had a certain definite meaning in the dissociation theory.

Dr. Gahl spoke in much the same strain, and others took part, though without bringing out any new or interesting points. Mr. Reed could not see that the arguments of the other side affected his statements at all.

Mr. Lawrence Addicks read a paper entitled "The Economic Balance in Electrolytic Copper Refining." This was a criticism of the paper read by Dr. Wilder D. Bancroft at the last meeting of the society upon electrolytic copper refining. In this paper Dr. Bancroft advocated higher solution temperatures and the use of covers in order to assist in this. Mr. Addicks objected to the conclusions reached in this paper, on account of the insufficient number of conditions considered. The problem was separated into three variables—tank resistance, age of electrodes and current density. Methods of varying these three were considered, and the advantages and the disadvantages involved in each change. In any case, there is a great multiplicity of relations which can only be solved a pair at a time and finally sifted down to the conditions most suitable for that particular case. No two refineries use just the same current densities and temperatures, as a difence in the cost of labor, power and supplies tips the economic balance to a new reading at once. The lowest cost per ton will not be the cheapest cost per ton, due to the fact that with a current density somewhat greater than that giving the lowest cost per ton the output may be sufficiently increased to give greater earnings, in spite of the higher cost per unit.

A discussion of this paper, submitted by Dr. Bancroft, in the author's absence was read by the secretary. Dr. Bancroft does not think the method of considering a pair of conditions at a time the best, and he questions whether Mr. Addicks had given all the factors. On the other hand, some of those mentioned were relatively unimportant. He pointed to the Anaconda and Great Falls plants, which, although in the same section of the country, operate under very different conditions, for no apparent reason.

In reply, Mr. Addicks thought that the difference in practice of the two plants mentioned only confirmed his views, and he emphasized the fact that he was in favor of high-current densities, and only vetoed a density too high.

A paper by Mr. Gustaf M. Westman, entitled "Remarks on Professor Joseph W. Richards's Theory of Heat of Neutralization, as Presented to the Society September 19, 1903," was read by Mr. Carl Hering. The author adopted the idea of a centrifugal force of the rotary movements of the molecules, as effecting diffusion of the substance in solution. Notwithstanding the fact that the osmotic pressure set up in this way follows the law of gases, neither the solution nor any part of it can be considered as a gas. Applying this to Dr. Richards's idea should show whether or not his theory holds good. The author objected to a number of the statements made in the Dr. Richards's paper.

Dr. Carhart, in discussing the paper, said that the author bases his conclusions on what he states as "facts," but his "facts" are merely extreme speculations.

Dr. Richards said that he did not understand the paper, and thought that some of the statements made in it tended to confirm his own position.

A paper by Dr. Louis A. Parsons, entitled "The Energy of Ions," was read by Mr. S. S. Sadtler. In this the author took exception to certain statements made by Mr. C. J. Reed, and explained his own ideas on the subject.

Mr. Reed, in reply, stated that there was nothing in the paper that seemed to require an answer. Dr. Parsons was merely putting forward a theory of his own.

A paper by Dr. Louis A. Parsons, entitled "The Aluminum Electrolytic Condenser," was read by Mr. A. B. Marvin. This describes the use, as a condenser, of two aluminum plates, immersed in a suitable electrolyte. The thickness of the film formed on the plates and upon which the action depends, had been estimated, by means of Newton's rings, to be from 0.000005 to 0.00005 centimetre. He stated that the condenser holds a constant charge, so that the capacity is only one-half that which would be supposed. The voltage is limited to 150, if a good efficiency is desired. The author has, however, operated a single condenser at 1,250 volts. The capacity is from one-quarter to one-half a microfarad per square inch of single electrode surface. The specific inductance capacity of the film is about ten, and the efficiency obtained may be as high as ninety-five per cent. Losses take place in the film, due to the resistance of the cell and to leakage. These increase with the frequency. Oscillograph curves of the action of such condenser curves were shown.

In the discussion of this paper, attention was called to the great dielectric strength of the film.

At the opening of the Saturday session, announcement was made of the election of officers, as follows: president, Dr. Henry S. Carhart; vice-presidents, C. J. Reed, E. G. Acheson and C. F. Burgess; managers, W. H. Walker, C. E. Acker and Edward Weston; treasurer, P. G. Salom; secretary, S. S. Sadtler.

The first paper read was by Dr. W. S. Weedom, entitled "A Contribution to the Study of the Electric Arc." An abstract of this will be published in the ELECTRICAL REVIEW. Discussing this paper, Mr. E. E. Creighton described the effect of wave-forms upon the voltaic arc, exhibiting oscillograph curves.

Mr. Hering suggested the use of a storage battery for research of this kind instead of a dynamo. He thought that the variations in the impressed electro-

motive force might affect the action of the arc.

Dr. Richards attributed the melting of iron in the arc before copper to the high conductivity of the latter metal, since copper melts at a much lower temperature than does iron.

A paper by Messrs. Isaac Adams and Barry MacNutt, entitled "Some Phenomena Observed in Connection with the Use of a Copper Voltameter," was read by Mr. MacNutt. This described the behavior of the copper voltameter when used by the authors in making a determination of the horizontal component of the earth's magnetic field. Although the battery employed gave a very constant electromotive force, the current passing through the voltameter dropped off rapidly, and whenever the circuit was broken, in order to reverse the current through the galvanometer, the new value of the current was less than that preceding the break. No explanation of this behavior was given. The determinations are believed to be accurate within one-tenth per cent.

A paper entitled "Electrolytic Iron," by Messrs. C. F. Burgess and Carl Hambuechen, was read by Dr. Richards. Electrolytic refining of iron has been carried on by the authors for some years. A method has been developed by which this iron can be produced commercially if desired. Heretofore pure iron has been a rare metal. The metal is hard and contains hydrogen, and is good for tools. Much time has been spent in developing this process. The most suitable solution was found to be ferrous sulphate containing ammonium sulphate. Suitable conditions are: a current density at the cathode of from six to ten amperes per square foot; a temperature of thirty degrees centigrade, and an electromotive force of one volt. The starting cathode plate is iron or steel, carefully cleaned of dirt and rust. The anodes are ordinarily wrought iron or steel plates, the pure material being more satisfactory for this use than the cast iron, as is true in copper refining. Much difficulty has been met in obtaining thick deposits, though now deposits three-quarters of an inch thick can be obtained in four weeks without changing the electrolyte. The current efficiency is about 100 per cent. The output of a vat is about 2.2 pounds per kilowatt-hour. It is possible to keep the electrolyte in a good condition, and as an idea of the expense of this process, it has been estimated that with power at $30 per kilowatt-year, the actual refining would cost one-half a cent per pound, giving a purity of material of 99.9. The product seems to contain nothing but hydrogen, which is easily driven off by bringing the metal to a white heat. The metal, as deposited, is hard and brittle, but, after heating, becomes tough and can be rolled. It is very difficult to melt without adding carbon, and the temperature required seems to be close to that necessary for platinum.

The hysteresis and permeability of the material have been investigated. These are affected by the presence of hydrogen, as boiling in water lowers the hysteresis losses several hundred per cent. The permeability is above that of the best Swedish iron, in some cases; in other cases, it is found to be less. The material should find use in investigating the properties of pure iron, and it should compete with commercial iron for making pure chemical compounds. On account of its brittleness, it is easily powdered, and it is not difficult to get large quantities at commercial prices.

Mr. W. McA. Johnson, commenting upon this paper, called attention to the importance of making experimental researches with large quantities of material, as had been the case in this instance.

Mr. Carl Hering said, that electrolytic production of iron by a wet process is not practical, on account of the large number of tanks necessary. He asked whether it would be possible to use cast iron for refining.

In reply, Mr. Johnson said that cast iron was of poor conductivity and would produce lots of scrap, which would give trouble by filling up the cells.

Mr. W. McA. Johnson read a paper entitled "Reaction Temperature Measurements on Reduction of Zinc Ores." This described a crucible made from Acheson graphite, which he had designed for his investigations. The crucible is enclosed within a furnace, and the temperature obtained by means of a thermo-couple placed just below the vessel containing the zinc ore. The mixture treated consisted of zinc ore mixed with charcoal, coke or graphite. The temperature in the furnace was raised until a zinc flame was obtained. This was observed and the temperature lowered until the flame disappeared. It was found that this point was marked very clearly, varying only two or three degrees with any one mixture. The reaction temperature, however, varies with the materials. Mr. Johnson believes that, in the reduction, a very important part is played by carbon vapor. He suggested the use of his crucible for distilling cadmium, to be used in preparing standard cells, and laid emphasis upon the value of the Acheson graphite in making furnace and crucibles for various uses.

Mr. C. J. Reed did not agree with Mr. Johnson as to the action of the carbon vapor. This vapor does not exist below 2,000 degrees centigrade; otherwise incandescent lamps would be impossible.

In reply to this, the point was made that the deposit of carbon on the inner part of the incandescent globe may be due partly to the passage of current, and not entirely to the temperature of the filament.

This being the last session for the reading and discussion of papers, other papers which had been printed were considered read. These were: "Observations on the Preparation of Electrolytic White Lead," by Mr. C. F. Carrier; "Dissociation by Means of the Alternating Electric Current," by William H. Davis; "Electric Smelting Experiments for the Manufacture of Ferro-Nickel from Pyrrhotite," by Ernst A. Sjöstedt. There was no discussion on these papers, and the meeting adjourned, after the society had extended a vote of thanks to the local committee, the Columbian University, the Cosmos Club and other organizations which had extended their hospitality.

The attendance at the meeting was rather disappointing, there being less than one hundred members present.

The social features were enjoyable. Thursday afternoon the members were received by President Roosevelt at the White House, and this was followed by a complimentary excursion on a trolley car through the city. In the evening a smoker was held immediately after President Richards's address.

Friday afternoon a visit was made to the navy yard and to the laboratories of the Bureau of Standards. In the evening a subscription banquet was held at the Shoreham Hotel.

On Saturday afternoon visits were paid to the Bureau of Engraving and Printing, and there was also a complimentary excursion by boat or by trolley to Mount Vernon.

Meeting of the American Institute of Electrical Engineers.

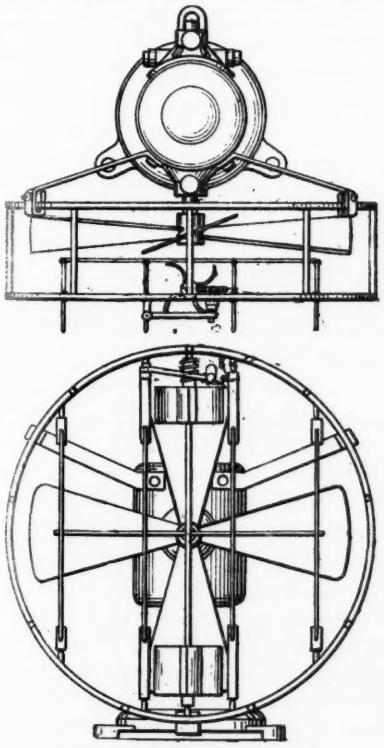
The 186th meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West Fifty-seventh street, Friday evening, April 22, at 8.15 o'clock. The following papers will be presented:

"The Mechanical Construction of Revolving Field Alternators," by David B. Rushmore, assistant electrician Stanley Electric Manufacturing Company, Pittsfield, Mass.

"Contribution to the Theory of the Regulation of Alternators," by H. M. Hobart and Franklin Punga, electrical engineers, London, England.

Electrical Patents.

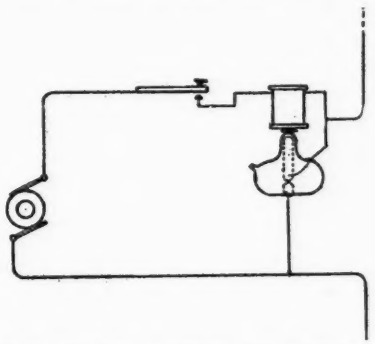
A deflector for fan motors has been invented by Mr. Harold R. Wellman, of New York, N. Y., and the patent obtained thereon has been assigned to the General Incandescent Arc Light Company, of New York. The invention consists of a device driven by the air blast of a fan motor which will give a uniform lateral oscillating movement to a series of pivoted shutters located in front of the fan blades of the motor. The object is to provide means for varying the direction of delivery of the air currents or blasts delivered from the fan of the motor. An electromotor is employed, a driven shaft, fans mounted on the shaft and a guard frame. The frame consists of front and rear members and transverse connecting members. A vertical shaft is provided having bearings located in the front member. Mounted on the opposite ends of this shaft are fans consisting of any desired number of blades. At the top of the shaft is a worm. A pinion depends from the front member



Deflector for Fan Motors.

and is mounted on a shaft having its bearings in a bracket. On the forward end of this shaft is a crank arm to which is pivotally connected a link, secured to one of the flat shutters. The shutters are connected together by means of a transverse rod and are pivotally supported in the front member. In operating the device, the air blasts from the fan impinge upon the blades of the small fans, setting them in rotation and imparting motion to the pinions, which motion is communicated through the links to the shutters, thereby giving the shutters a to-and-fro motion or otherwise oscillating them on their pivots.

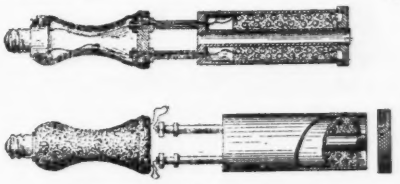
Mr. Daniel M. Moore, of Newark, N. J., is the inventor of a peaked wave wireless transmission, which relates particularly to the manner of primarily exciting or



Apparatus and Circuits for Producing Peaked Wave Wireless Transmission.

producing the waves of radiant energy, and consists substantially in setting up or originating in any proper manner changes of electrical condition or polarization which by reason of their high rate of change will be better suited to produce radiating spheres or lines of wave action that will propagate themselves for greater distances and will act with greater power upon the receiving apparatus. The invention consists in the improved method of propagating such waves by producing changes of primary exciting electric potential or polarization, which if graphically described as a series of waves show a series of waves of highly peaked form. Such changes may be produced by interrupting a charged circuit in a high vacuum through simply bringing the two electrodes or contacts of the circuit into and out of contact with one another while included in the vacuum. In this way the contacts may serve practically the double purpose of the ordinary make-and-break device heretofore employed in Hertzian wave telegraphy and the function also of the electrodes of the oscillator or radiator separated by a space over which the discharges primarily produced by the vibrator take place. By "high vacuum" is meant one in which the exhaustion has been carried to the highest possible degree. The higher the vacuum the better for the purpose of the invention. The essence of the invention consists in producing in any manner changes of electric condition or potential for the purpose of developing the free electromagnetic wave radiated through space, by causing changes of electric potential or condition of predetermined form or rate of change which, graphically represented, may be described as a wave or pulse of extremely peaked form, and while the use of a high-vacuum break is the most effective means of setting up such ether vibrations or electromagnetic waves, Mr. Moore does not limit himself to such use, since the same accentuated change of electric potential or condition in a wire or conductor might be produced by generating the electric potentials directly in a properly designed dynamo electric machine.

Mr. James F. Hathaway, of San Francisco, Cal., has assigned to Felix B. Mulgrew and Julius M. Alexander two-thirds of his interest in a patent recently obtained by him on an electric water heater. Within the outer casing of the heater is located the heating coil. This coil surrounds a hollow core which extends through the head of the casing and on to the lower end of which screws the bottom of the casing, which also screws on to the lower end of the casing. These parts constitute the body of the heater which is designed to be placed into a receptacle containing the water to be heated. By



Electrical Water Heater.

forming the body with a hollow core which extends through the bottom, the water is permitted to enter within the body of the heater to a height equal to the depth at which the heater is placed into the water, say, about two-thirds the length of the body portion. By this manner of constructing the heater body the water is exposed to the outer heated surface of the metallic casing and the inner heated surface of the hollow metallic core, a greater heating surface being thus provided. The body is provided with a suitable handle, through which extends insulated wires, one end of which connects to a plug held in one end of the handle by means of set screws. The other end of these wires is suitably arranged to connect with the heating coil in the body of the heater. In the present instance the handle is formed of vulcanized rubber.

Carborundum, made in the electric furnaces at Niagara Falls, N. Y., is nearly as hard as diamond—but is too fragile for use as a substitute in diamond drills. As an abrasive, carborundum is superior, but it has not as yet been applied to rock boring.

Reviews of Current Engineering and Scientific Literature.

The Output and Design Coefficient.

In this communication Mr. A. Press offers an output and design coefficient which will take into consideration the radiating length of the armature. From experimental data, which include tests on such high-speed machines as direct-current turbo-generators, it has been found that the watts radiated per square unit of surface per unit of peripheral speed for a given temperature rise can be taken satisfactorily as the constant. In all cases the radiating length—that is to say, the total length of the armature conductors —has been assumed. From this fact the following is the output equation proposed:

$$W = s \text{ revs. } D^2 (L + l)$$

in which W is the output, D the diameter of the armature, L the core length, l the length of the connections, and s a design coefficient which is equal to the final temperature rise, multiplied by the product of the armature loss, expressed in hundredths, and the percentage of energy lost. The author suggests that if this equation is used to compare machines of different types, the design factor should in each case be divided by the temperature rise.—*Abstracted from the Electrician (London), March 25.*

Compound Locomotives in France.

A valuable paper on the steam locomotive was read recently by M. Edouard Sauvage, chief consulting engineer of the Western Railway, of France, before the British Institution of Mechanical Engineers. In this the author gives very complete details of the construction of the three types of locomotive now in use, and a number of results of actual runs. Powerful locomotives may be classed in three divisions—the Atlantic type, for express service; next, the class with the three coupled axles and the bogie in front, which is equally good for fast freight service and ordinary passenger service; and the third type, intended for heavy freight service. The author thinks four coupled locomotives may still be useful if they are made more powerful and built with the four cylinders working compound, and have, in addition to the eight coupled wheels, a pony truck in front. In some cases the same boiler may be used for all three types. The grate areas are thirty and thirty-four feet, and there are about 2,500 square feet of heating surface. Some interesting results of a powerful locomotive of new design, which has been put into service on the Paris-Orleans railway, were given. The weight of the train was 350 tons, exclusive of the locomotive and tender. It was run for nearly 200 miles at an average speed of fifty miles per hour; and for seventy-three miles, the average speed was sixty-three miles an hour. Indicator diagrams showed that the effective tractive power of the locomotive was from 1,200 to 1,800 horse-power. The water consumption was twenty-four pounds per horse-power per hour, and the coal burned was one pound per 7.7 pounds of water evaporated. These results were thought to indicate that the four-cylinder compound locomotive was efficient, handy and economical.—*Abstracted from Engineering (London), March 25.*

An Electrogoniometer.

An electrical device for measuring phase angles has been devised by M. Chaumat, who has described his apparatus and given the theory of its operation in a communication recently read before the International Society of Electricians. The power-factor of an electrical circuit is the ratio of the true power to the product of the effective currents and voltage. If the current and voltage vary according to the sine law, this ratio is equal to the cosine of the angle displacement between current and voltage waves. M. Chaumat, by means of Fourier's theorem, shows that within certain limits this ratio may be assumed to be the power-factor for the equivalent angle of lag between waves of any form. The device which he has developed for measuring the angle of lag is for three-phase circuits only, and consists of a small series transformer connected in one of the lines, and a device for obtaining an electromotive force constant in value but varying in phase. These two devices are connected in the circuit in series with two voltmeters, one for reading large values of voltage and the other for indicating small values. The transformer is shunted with a non-inductive resistance. In making a measurement, the electromotive force set up by the phase-shifting device is adjusted in phase until it is just opposed to the electromotive force given by the transformer. When this setting has been made, the angular displacement is indicated by the instrument. The phase-displacing device consists of three non-inductive resistances connected in star, with an arrangement for tapping from various points on two of the legs, this being done in such a way as to shift the phase of the resultant electromotive force, without changing its value.—*Translated and abstracted from La Revue Electrique (Paris), March 15.*

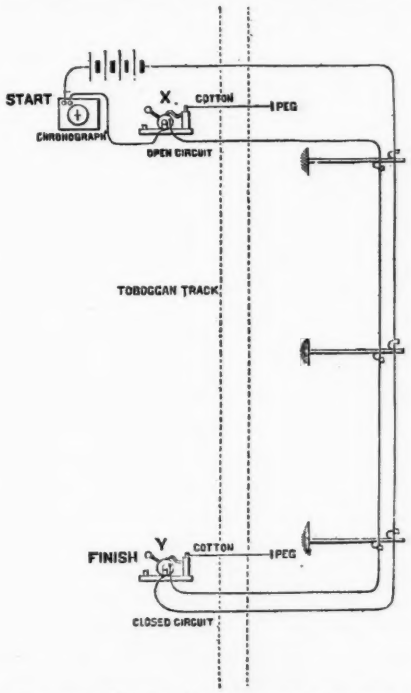
The Hydroelectric Stations of the Alta-Italia Company.

An important electric enterprise of Italy is that of the Societá Anonima Elettricita Alta-Italia, of Turin. This company distributes electric power in Turin for public and private lighting service, for motor installations and for several tramway lines. In addition to this, other municipalities within the radius of its distributing network are supplied. The two principal stations are situated at Bussoleno, in the valley of Susa, and at Funghera, in the valley of Lanzo. The three supplementary stations are on the Stura river, between Ceres and Ala. In addition to these, the company has another large station for the conversion of hydraulic into electric power in Piedmont, at a point on the Chiusella river. This station supplies light and power to the towns of Biella, Strambino, Cuorgnè, Rivarolo, San Giorgio and others. At the Bussoleno station there are five turbines, three of 750 horse-power each, and two of 120 horse-power each. Each of the principal turbines is connected by a flexible cable to a 690-kilowatt three-phase alternator. One of these groups is held in reserve. The two small turbines each drives directly an exciting dynamo of seventy-five kilowatts at 120 volts. From the bus-bars upon which the 450-volt current is collected, it is taken to step-up transformers. The transformer battery is placed behind the switchboard, and consists of seven three-phase transformers, each of 200 kilowatts capacity, and with a transforming ratio of 450 to 12,000. The transformers are cooled by natural ventilation. The current generated at Bussoleno is also transmitted to Turin, a few horse-power only being taken off for a dynamite factory at Avigiliano. It is first transformed to 3,000 volts in a special station; then, in conjunction with the current brought from the Lanzo station, it is used either for driving the motor dynamos in the Via Bologna station, where it is transformed into continuous current for railway and lighting service in the central part of the city, or, after a second transformation to 120 volts, is distributed for light and power purposes

in the outlying districts. As the demand for electric power is constantly on the increase, the company will ultimately bring its transmission capacity from Bussoleno to Turin up to 1,800 horse-power, and that from Funghera to 6,500 horse-power. The transmission line to Turin is about fifty-eight-kilometres long. It is supported on wooden poles, into which are screwed iron pins carrying the insulators. This article, which is by Signor Enrico Bignami, also describes in detail the Ceres plant on the Stura de Ala, which utilizes hydraulic power to the extent of about 4,500 horse-power, and the Funghera power station, which utilizes 3,000 horse-power, as well as the Ponte dei Preti power station, which contains five turbines, three of 750 horse-power, each coupled to 640-kilowatt 440-volt alternators, and two smaller machines for the exciter dynamos. The Biella power station distributes the current of the Ponte dei Preti station.—*Abstracted from the Engineering Magazine (New York), April.*

The Electric Timing Arrangement on the "Cresta," St. Moritz.

St. Moritz is one of the highest villages in the Engadine, having an altitude of about 6,000 feet, and is a great centre of winter sports. This resort has the reputation of drawing together the most daring and skilful tobogganists in the world. The name "Cresta" is derived from a small village of that name near the finish of the course. The course is a little over three-quarters of a mile in length, with a difference of elevation from the start to the finish of about 600 feet, and the gradient varies at different points. Only one toboggan can occupy the track at a time, and the races are all decided by the time taken to complete the course. The record at present from the start to the finish is 61.6 seconds, this entailing a speed of sixty miles an hour or more on the fastest parts. At the side of the course there is a pole line carrying four overhead wires on ordinary porcelain insulators. The two upper wires are connected to a telephone at each end to allow of communication between the officials in charge and the starting and finishing points. The two lower wires are connected to the timing apparatus. This is arranged as may be seen from the accompanying illustration. At the starting point one overhead wire is connected through a battery of ten cells to one terminal of a chronograph, the other terminal being connected through the trigger switch X to the other overhead wire. The further ends of the overhead lines are connected at the finishing points to another trigger switch Y. Both switches X and Y are firmly fixed at the side of the course, and each has a strong cotton line attached with one end to the trigger of the switch. The line is stretched across the track about two and one-half inches from the ground, and the other end is tied to a peg driven into the ground on the further side. The switches X and Y are nearly identical, and consist of circular wheels of brass, mounted on proper bearings, and having notches cut in their peripheries, in which a pawl is placed when the trigger is set. A radial arm is fixed to the wheel. This arm has at its end a heavy brass knob, which causes it to fall by gravity when the pawl is disengaged by the cotton being pulled. At the lower



ELECTRIC TIMING ARRANGEMENTS ON THE "CRESTA," ST. MORITZ.

edge of the wheel a piece of ebonite is inserted, in slightly different positions in the two switches. Contact is made by a spring which presses against the underside of the wheels. When the pawl is set in the notch in the two switches, the spring under the switch X is pressing against the piece of ebonite in the switch disc, and the spring underneath the disc in switch Y is making contact with the wheel. Before the toboggan starts both switches are set with the pawls in the notches, and the cotton is stretched from the trigger across the track at the starting and finishing points. At the signal, the tobogganist starts a few yards behind the cotton. His toboggan, striking the cotton, pulls and breaks it, disengaging the pawl. The arm drops at switch X, closing the circuit, allowing the current to flow through the electromagnet of the chronograph, the armature releasing the clockwork, which immediately starts and continues until the cotton attached to the switch Y is pulled and broken by the toboggan at the finish of the course, when the arm of the switch Y falls and breaks the circuit, stopping the chronograph. The time is then noted, and the apparatus reset for the next tobogganist.—*Abstracted from the Electrical Review (London), April 1.*

The Laboratoire Central D'Electricite at Paris.

The laboratory which is here described by Mr. Albert Campbell was founded in 1888 by the Société Internationale des Electriciens, and, up to the present time, about $100,000 has been expended on it. The object of the founders was to afford the manufacturers and the public an independent tribunal for testing all kinds of electrical apparatus. It is under the control of a committee, which at present includes a large number of the most eminent scientists and electrical experts of Paris. The sources of energy available include a commercial circuit, supplying alternating current at forty-two cycles per second, and a private installation, a steam engine, gas engine and five batteries of storage batteries. The switchboard is arranged so that any supply of energy may be connected to any circuit. For this purpose spring switches are employed. The testing work is carried out in a series of rooms, each of which is fitted for a particular class of work. The calibrating room can handle any currents up to 3,500 amperes, by tenths of an ampere. The system of regulation is very simple and effective, consisting of a set of forty resistances graduated in suitable steps. There is a knife switch in series with each. By means of these switches the resistances can be put in parallel to give any current required. In the iron-testing room the rings used in the ballistic method are unusually large, being thirty centimetres in diameter and nine centimetres in cross-section. There is a well equipped photometric department. The incandescent lamps used for secondary standards are mounted in a holder making contact with the supply through mercury cups. These are arranged so that the lamp may be turned about its axis so as to set it in the correct position, this being indicated by the position of certain bright spots thrown by the lamp upon the wall.—*Abstracted from the Electrical Review (London), March 25.*

SMALL FIRE IN THE SUBWAY DOES MUCH DAMAGE TO TELEPHONE AND TELEGRAPH WIRES.

UNCOMPLETED CONDITION OF UNDERGROUND RAPID TRANSIT, NEW YORK CITY, AFFORDED OPPORTUNITY FOR UNUSUAL INTERRUPTION OF SERVICE.

At the corner of Fulton street and Broadway, New York city, not far from the main office of the Western Union Telegraph Company's office, and from the headquarters of the New York Telephone Company at Cortlandt street, an accident took place owing to ignition of a pot of paraffin. The fire was communicated to some telephone and telegraph cables which were temporarily supported in the rapid transit ditch immediately under the planking which covered it. The fire began at about nine o'clock on the morning of April 6, and in fifteen minutes more than twenty-two telephone cables carrying over 5,000 wires were placed out of service. Wires of the Postal Telegraph Company, Western Union Telegraph Company, Gold Stock and District Telegraph companies, and wires of various other concerns, were all involved in the mess.

The business at the Cortlandt street office was entirely suspended, owing to the overload placed upon the storage batteries and ringing machines. This made it impossible to receive at the central office any signals or to send signals from there. Intense excitement was created in the neighborhood and the fire department was called out to extinguish the flames which had been communicated to the timbers of the subway construction.

Although the area covered by the fire was limited to a spot not twenty feet square, the damage produced was extensive and serious. All of the lines centering in Cortlandt street exchange were rendered inoperative. All of the trunk lines from that office to every other office north and east were interrupted. The trunk lines from the Broad and John street central offices also passed through the place in which the fire took place. These also were interrupted so that communication to offices north of Fulton street was rendered impossible. The Brooklyn wires extending from Cortlandt street were also out of service. All of the long-distance wires extending to Connecticut, Rhode Island, Massachusetts and other eastern points were put out of service, as were long-distance wires extending in the direction of Buffalo. The direct loss to the telephone company was small, probably not amounting to more than $5,000. The indirect loss, due to loss of service and the inconvenience caused to the subscribers and the public generally, reached figures which never can definitely be known. The mayor of the city is quoted as saying that the city's business was practically suspended. Many banks and other financial institutions and large companies found it impossible to carry on their business by messenger and practically suspended work for the time.

A large force from the construction department of the telephone company was immediately sent out to the scene of the trouble and in less than two hours the long-distance service was restored. By night several hundred trunk lines were put back into service and a good start was made on the subscribers' circuits. On the evening of Thursday, owing to the work of relays of experts, the entire telephone service was working normally.

The public took the interruption good-naturedly and sympathy with the telephone company and telegraph companies was extended by all. The general sentiment of the community was that this accident had served to remind them of how dependent they are upon the telephone, and expressions were generally heard to the effect that this interruption merely served to emphasize the regularity with which the service is ordinarily rendered.

Considerable excitement was created at the telephone central office, owing to the fact that thousands of signals were simultaneously received, but it was impossible to communicate with any of the subscribers. The situation was ably handled by the telephone officials and nothing in the nature of a panic took place, although the extraordinary confusion produced by the lighting of thousands of signal lamps, the blowing of fuses and the operation of circuit-breakers produced conditions which had never before been observed in a telephone central office.

The first care of the telephone officials at the central office was to disconnect from the system all of the defective wires leading through the burned-out cables. This at once removed the overload. The circuit-breakers were put back and thousands of subscribers in Cortlandt street not immediately concerned in the burn-out were enabled to communicate with the central office. This was of little use to them, however, because it was impossible for them to communicate to any point outside of their own central.

The occurrence of this accident is a result of the extraordinary conditions created by the construction of the Rapid Transit subway and could not occur if the cables were in their natural condition in the ducts and in the fireproof manholes of the subway company. That such an accident as this has not happened before is surprising in view of the fact that throughout Manhattan Island, along the entire route of the Rapid Transit subway, the telephone cables have been placed temporarily in the greatest confusion.

International Association of Municipal Electricians.

At a meeting of the executive committee of the International Association of Municipal Electricians, held at Brooklyn, N. Y., April 2, it was decided to hold the next convention at St. Louis, Mo., on September 13 and 14. This is also the week of the International Electrical Congress. Mr. Frank C. Mason, superintendent of police telegraphs, New York city, was selected as delegate to represent the municipal electricians at the congress.

The following papers were selected and assigned to be read at the annual convention, St. Louis: "Street Lighting—Principles Involved and Systems Used," A. S. Hatch, Detroit, Mich.; "The Limitations of the Telephone for Fire-Alarm Purposes," Adam Bosch, Newark, N. J.; "The Inspection of Theatres from an Electrical Standpoint," William H. Thompson, Richmond, Va.; "Methods of Testing," Walter M. Petty, Rutherford, N. J.

The following members were present at the committee meeting: W. H. Thompson, Richmond, Va.; J. Murphy, Cleveland, Ohio; J. W. Aydon, Wilmington, Del.; A. C. Farrand, Atlantic City, N. J.; W. H. Bradt, Troy, N. Y.; F. P. Foster, Corning, N. Y.; Adam Bosch, Newark, N. J.; W. M. Petty, Rutherford, N. J., and Frank C. Mason, Brooklyn, N. Y.

Advance in Prices of Platinum.

Platinum and its allied metals, which depend almost entirely upon the Ural mountains for their crude supply, have already felt very decided results of the Russian-Japanese War, owing to heavy withdrawals of forces from this mountain district by the Russian Government, the effect of which has naturally caused an advance in current rates.

For some time there has been an increasing demand for platinum and its alloys in the electrical and chemical fields, which is constantly being supplemented by the increasing use of gas engines, automobiles and various new electrical appliances, having platinum contacts and attachments. This growing demand, with doubtless a long continuance of the present situation in Russia, would strongly point to a further advance in a very short time.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Fuse Plug Cabinet Panels.

The line of cabinet panels manufactured by the General Electric Company, Schenectady, N. Y., has been received with favor by contractors and architects

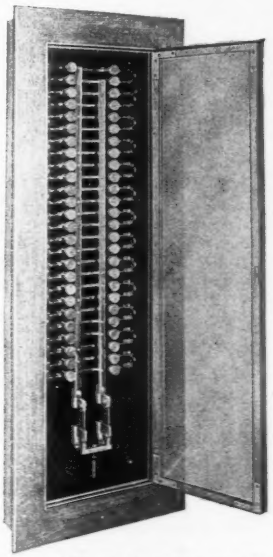


FIG. 1.—FUSE PLUG CABINET FOR TWENTY-SIX CIRCUITS.

throughout the country. They are furnished for 125 and 250-volt service, in a variety of arrangements and circuits to meet the requirements of practically all

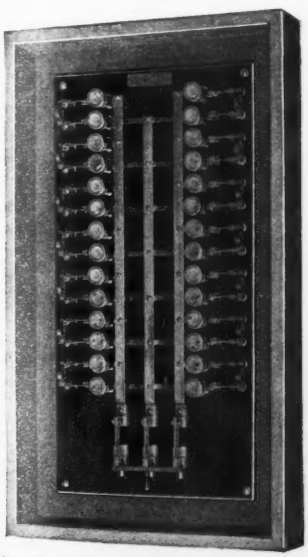


FIG. 2.—FUSE PLUG CABINET FOR TWO-WIRE DISTRIBUTION FROM THREE-WIRE MAINS.

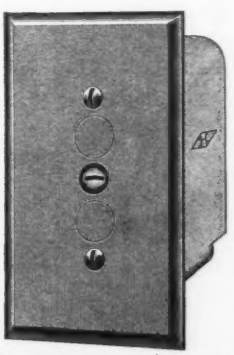
installations. The distinctive feature of these panels is the employment of the well-known Edison fuse plugs on the different circuits. With the plug type of panel the bus-bars and connections are placed considerably below the level of the tops of the plugs, rendering remote the liability of a short-circuit. The fuse plugs furnished with the 125-volt panels are fitted with a mica cap which enables one at a glance to know on which circuit the fuses have blown.

The 250-volt panels are fitted with a reloadable type of fuse plug which are easily inserted without danger of shock. These panels are neat in appearance, compact and well finished, and due to the nature of the Edison plug no injury to the panel itself can take place when the fuses blow.

Fig. 1 shows a cabinet panel for twenty-six two-wire, double-branch circuits from two-wire mains with main and circuit switches, while Fig. 2 shows a somewhat smaller panel arranged for fourteen two-wire, single-branch circuits from three-wire mains with main and circuit switches. The spacing of the different panels is in conformity with the rules of the National Board of Fire Underwriters.

Flush Receptacles and Plugs.

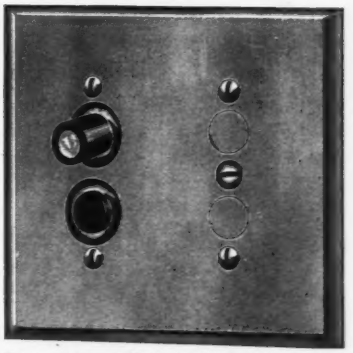
The accompanying illustration shows two forms of flush receptacles and plugs which the Hart Manufacturing Company, Hartford, Ct., is placing on the market. As may be seen from the illustration, one of these is a simple plug switch, and the other is a combination of push-button switch and plug receptacle. In either of



FLUSH RECEPTACLE, WITH GUIDE HOLES.

these forms the circles indicate the closed apertures for the contact pins carried by the plug. These circular discs are automatically opened for the reception of the plug, and close again upon its withdrawal. The pilot pin in the centre of the plug is inserted in the slotted hole in the face of the plate. The plug is then pushed in until the contact pins carried by the plug engage the contact clips in the body of the receptacle. The shutter which closes the holes in the face of the plate is automatically operated by the pilot pin.

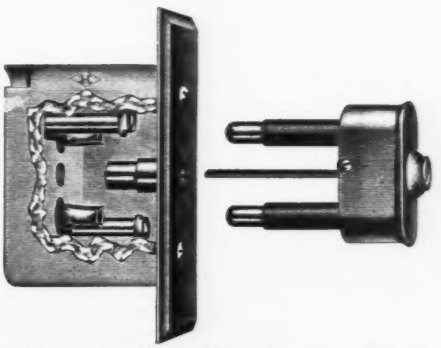
Flush receptacles are made in gangs of any number, or in gangs with "Diamond H" push or rotary flush switches. These will fit standard wall appliances made for push-button or rectangular base flush switches. When used with "Diamond H"



COMBINATION FLUSH RECEPTACLE AND PUSH SWITCH.

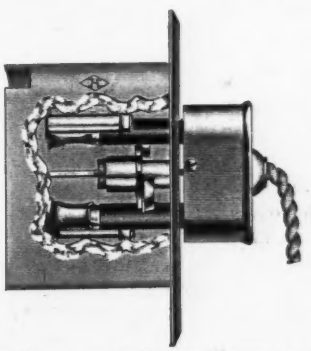
steel wall cases (on old work) they require C receptacle plate.

This form of plug switch and receptacle



MECHANISM OF FLUSH RECEPTACLE AND PLUG.

is deservedly becoming very popular. The receptacle and plug requires but one hand to operate it, and the shutter can not be

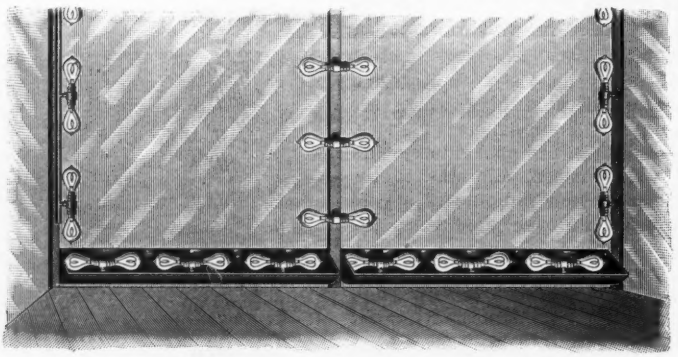


PLUG INSERTED IN FLUSH RECEPTACLE.

left open, as it closes automatically upon the removal of the plug. The porcelain body of the plug is enclosed in a finished steel shell, which prevents accidental breakage; and it is impossible to produce a short-circuit or a ground by the insertion of the plug.

A Twin Socket for Incandescent Lamp Illumination.

The Benjamin Electric Manufacturing Company, Chicago, Ill., maker of wireless clusters and electrical specialties, has designed a new form of twin socket for incandescent lamps, which is particularly adaptable for window lighting. The accompanying illustration shows a show-window fitted out complete with Benjamin twin sockets. With this system of window lighting, the lamps are always in pairs, which gives a balanced effect, whether used with window reflectors or on the centre rail or sides of windows. In all cases only one-half the number of connections is required for a given number of lamps, as the socket is so constructed that one set of wires feeds both lamps. The socket may be attached to the pipe or tube by means of threaded nipples, as shown at the right of the illustration; or it may be attached to the capping of the moulding by means of nipples or flanges, as shown at the left of the illustration.



METHOD OF UTILIZING TWIN SOCKET.

TWIN SOCKETS HELD TOGETHER BY SNAP.

The socket is lined and is easily connected, the shell being made in two pieces which snap together, no screws being necessary.

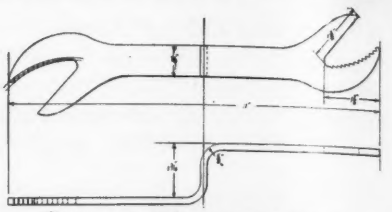
The Benjamin company reports a rapid increase in the sale of its wireless clusters, signs and specialties, and announces that it will have a complete exhibit in the Electricity Building at the St. Louis Exposition.

Two Novelties for Electrical Work.

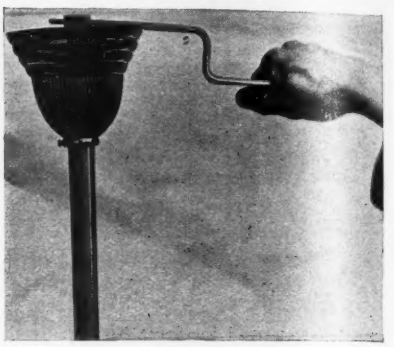
The Applied Device Company, Springfield, Mass., has placed on the market two novelties which meet a distinct want in their particular fields, and are consequently rapidly becoming popular. The accompanying illustration shows one of these, which is designated as the "Electrogrip." This is a universal adjuster for suspended electric lamps. It consists essentially in a spring contrivance which grips the socket of an incandescent lamp, and which has at its other end two eye-springs covered with rubber tubing. By pressing the arms to the centre the jaws are opened, and upon releasing the arms the springs close tightly around the object from which the lamp is to be supported.

Another novelty which this company is manufacturing is a wrench for the electrical fixture men. This has a one and three-quarter inch offset, to allow close working to the wall or ceiling. Each wrench has two jaws for left and right-hand work. The jaws are made on an improved principle. The wrench has a fixed and flaring jaw, the combination of a grasping jaw and serrated face, with a bearing jaw having a straight bearing face. In this way it both grasps and releases a pipe with ease and certainty, the curved outline of the pipe finding a tangential bearing in all parts of the opening. The curved jaw first engages the pipe, and then the straight jaw slips under or around the pipe until jammed tightly into the opening between the jaws, this connection being entirely automatic. The wrench can be used with any pipe from five-sixteenths of an inch to one and one-sixteenth of an inch in diameter. The manufacturer states that this instrument is made from a forging of the finest tool steel. The teeth are accurately milled and hardened in the best possible manner.

THE "ELECTROGRIP."



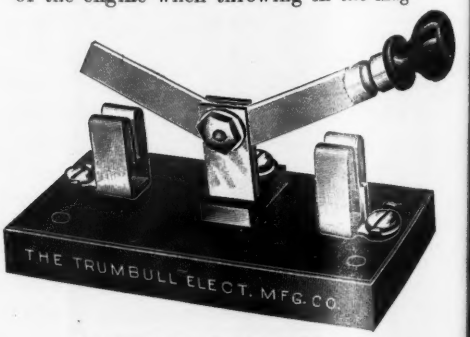
COMBINATION ALLIGATOR WRENCH.



ALLIGATOR WRENCH FOR WORKING CLOSE TO CEILING.

The Trumbull Magneto and Battery Switch.

The accompanying illustration shows a special magneto and battery switch for gas and gasoline engines, made by the Trumbull Electric Manufacturing Company, Plainville, Ct. The construction of this switch is such that it is impossible to miss an ignition, thereby losing a stroke of the engine when throwing in the magneto or a fresh set of batteries. The size of the base is two by four inches. This switch is well constructed, and the contact parts are especially finished for the class of work for which it is designed.



MAGNETO AND BATTERY SWITCH.

The New York office of the Trumbull Electric Manufacturing Company is at 136 Liberty street.

Electrically Driven Centrifugal Pumps.

The pressing desire on the part of many managers of deep mines and other plants where high-head pumping is essential that a practical centrifugal pump for this class of service be designed, has led many prominent manufacturers to undertake the solution of this mechanical problem. Centrifugal pumps have for some time labored under the disadvantage of a strong prejudice against their use for high-head service. Their great value for moderate lifts, and where volume only was essential, has long been recognized, but it is only recently that they have been successful in deep-well work. The reason for this lies principally in the necessary mechanical design of the centrifugal pump. However, the simplicity of this apparatus and the rigidity with which it may be constructed, due to its few parts, would make it of great value, should the design be so effected as to warrant its installation for very high lifts.

Working along this line for a number of years the Henry R. Worthington Company has produced a line of centrifugal pumps of three distinct types. These centrifugals are made for any service for heads up to 2,000 feet, and introduce a radical departure in the utility of centrifugal pumping apparatus. The first of the three classes into which these pumps are divided is the conoidal, which are designed for especially low lifts and large deliveries, and are adapted to irrigation work, the handling of sewage and similar purposes. These are comparatively in-

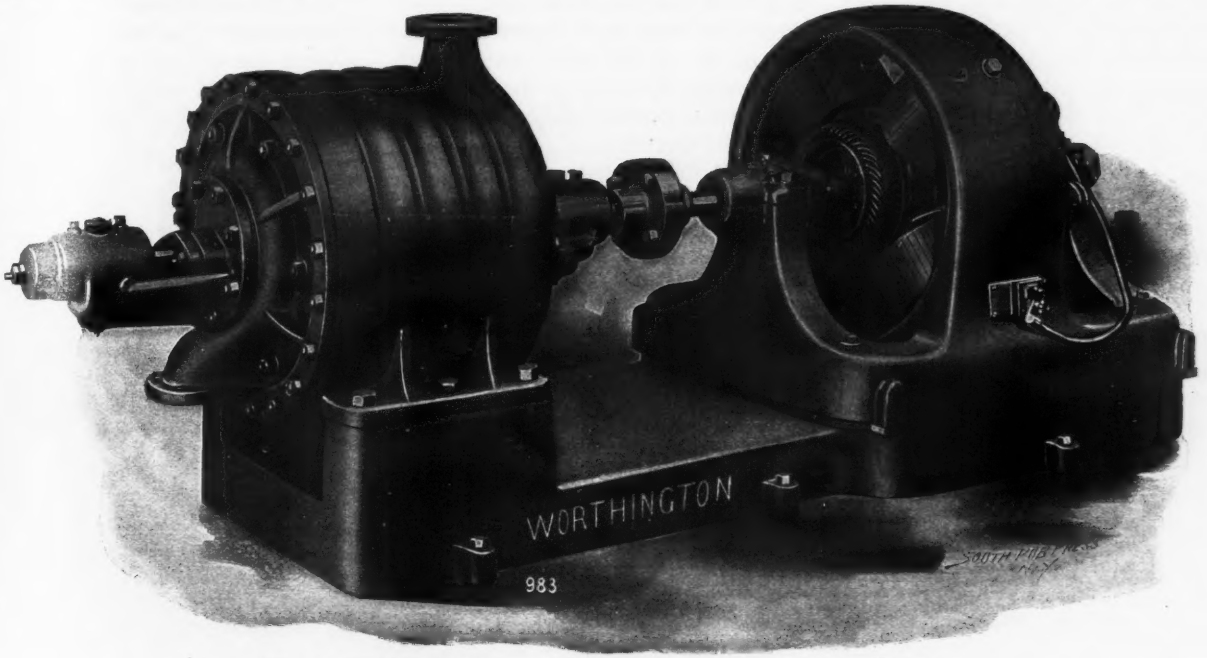


FIG. 1.—FIVE-STAGE TURBINE CENTRIFUGAL, DRIVEN BY ELECTRIC MOTOR.

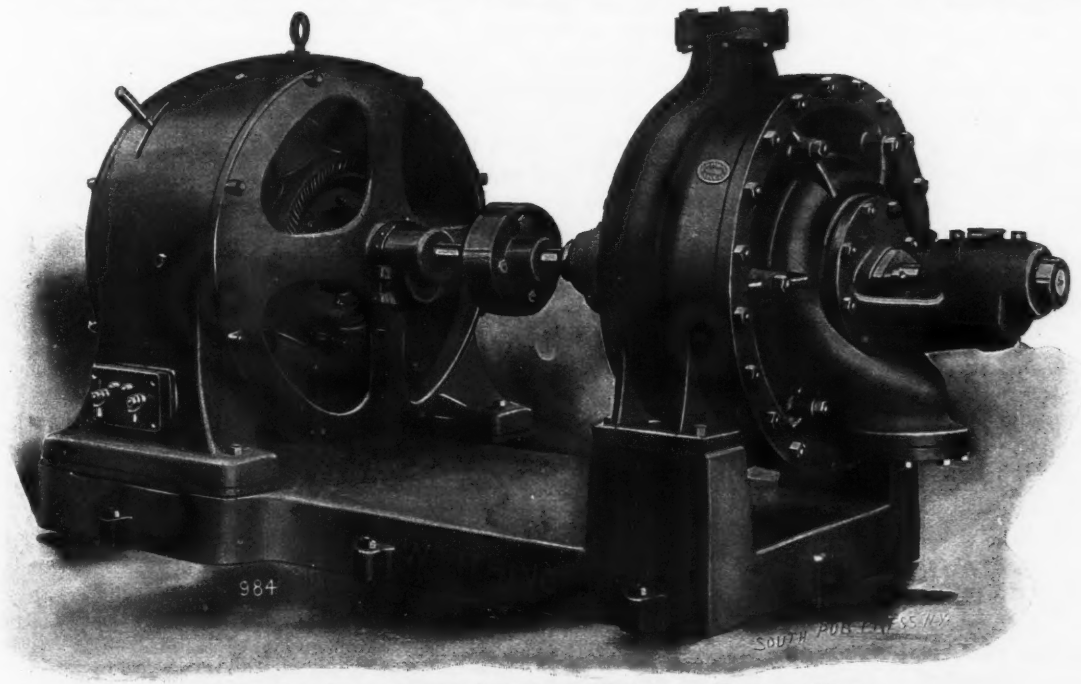


FIG. 2.—TWO-STAGE TURBINE CENTRIFUGAL, DRIVEN BY ELECTRIC MOTOR.

expensive, and operate at high rotative speeds, making possible direct-connection with electric motors. Volute centrifugals are built for medium lifts, but for all capacities. These pumps are recommended for heads up to seventy feet. The third class is the turbine pump, which is probably the most successful, and is suited for very high lifts, sometimes exceeding 2,000 feet. These are especially adapted to driving by electric motors.

Figs. 1 and 2 show, respectively, a five-stage and a two-stage turbine pump. The first pump is for deep-mine and other service where heavy pressures are encountered, and is adapted for any capacity and for heads up to 750 feet. The two-stage turbine pump shown is also used in mine service, and has a capacity of 500 gallons per minute against a 200-foot head.

This turbine pump has been developed by a long series of experiments. The diffusion vanes, which form the distinguishing feature, take the place of the usual "whirlpool chamber" in other forms of centrifugals, and assist in bringing the water to rest without internal commotion or shock. These diffusion vanes correspond in function to the guide vanes of turbine water-wheels. The difficulty presented by high-lift centrifugals, where only one impeller is employed, has been overcome in the Worthington multi-stage turbine by mounting a number of discs or impellers, each operating in a separate chamber, upon a single shaft, and passing water through the impeller chamber in succession. In this way the lift can be multiplied three, four or five times, while the number of revolutions is kept within such bounds that it is possible to connect the pump directly to an electric motor.

These pumps are made both in horizontal and vertical types, and their adaptability to the electric drive, using either direct or alternating current, is making them very popular. A notable instance of a recent installation using these high-lift centrifugals is at the Rotterdam pumping station, Rotterdam, N. Y., which the Schenectady Railway Company, of Schenectady, N. Y., has just installed, driving two large vertical centrifugals by 800-horse-power induction motors.

The Warsaw Electrical Exhibition Cancelled.

The proposed electrical exhibition, which was to be held at Warsaw, Russian Poland, has been cancelled owing to the belief of the promoters that pending the Russo-Japanese conflict such an exposition would not pay.

An Electric Light Plant for Launches and Yachts.

The accompanying illustration shows a generating set manufactured by the Carlisle & Finch Company, of Cincinnati, Ohio. This plant consists of a gasoline engine of two and one-half horse-power, direct-connected to a multipolar dynamo. The dynamo will furnish sufficient current for twenty incandescent lamps of sixteen candle-power each, or it will carry a 1,500-candle-power searchlight and ten sixteen-candle-power incandescent lamps. The engine and dynamo are mounted on a cast-iron base, which is accurately planed off on top so as to bring all bearings in alignment. The engine shaft is an open-hearth steel forging with balance weights forged solid on the crank arms. The bearings are large and ample, and the manufacturer claims will not heat or cut.

The armature is built up on a sleeve which may be removed from the shaft by taking off the bearing at the commutator end and pulling it off. There is no need of removing the dynamo or the shaft from the engine.

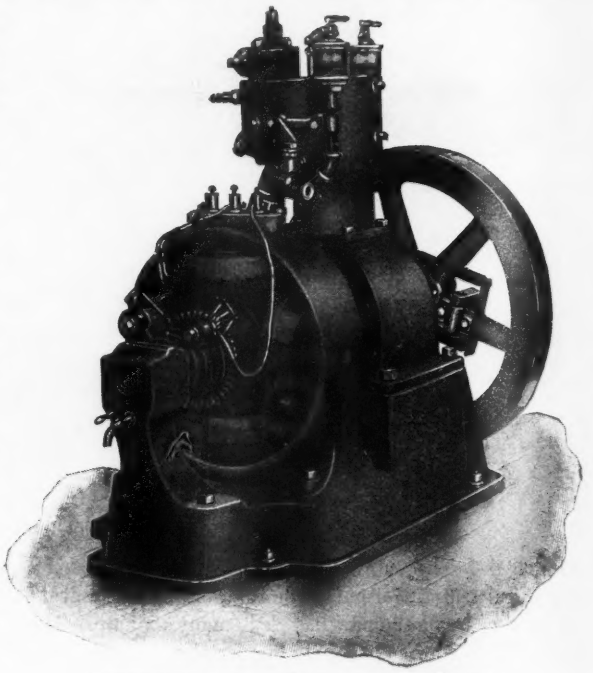
The governor is fitted to the flywheel, which operates direct on the exhaust valve. This maintains the speed within two per cent variation from no load to full load.

On one side of the engine is a circulating pump for pumping cooling water through the water-jacket.

Three sight-feed lubricators are provided, two for the cylinder and one for the connecting rod. The other bearings are self-oiling, and are provided with reservoirs packed with waste for retaining the oil.

Owing to the heavy flywheel and the speed at which the engine runs, the lights are steady and there is no disagreeable flicker.

The specifications on this engine are: floor space, twenty by thirty-four inches; height, thirty inches; weight, 475 pounds; speed, 750 revolutions per minute.



GENERATING SET FOR LAUNCHES AND YACHTS.

An Echo from the Baltimore Fire.

There is a boy in Baltimore who thinks that the recent fire was not such a bad thing after all. While snooping among the ruins, he came across what the fire had left of a small Crocker Wheeler motor. He gathered up the castings and wrote a letter to the manufacturer describing his find, and closing thus: "Can I wind the armature so as to use it as a direct-current series-wound dynamo? If so, what size and how much wire must I use on the field magnet and armature? How many coils must I divide the armature into? Thank you very much for the information you can give me," etc. Many a collector of souvenirs has carried things away from the scene of the fire to be placed in curio-cabinets and on rural mantel-shelves, but this young Franklin knows a trick worth two of that.

An Impressive Machine Tool Catalogue.

The Niles-Bement-Pond Company, New York city, has recently published a magnificent catalogue illustrating and describing the products of its various manufactories. This catalogue embraces some seven hundred and odd pages, and is printed on heavy white stock and bound in cloth in a most substantial manner. The general index alone takes up some six pages. There is listed and described in this catalogue almost every conceivable form of machine tool, from the tiny reamer to the immense shear and punch, and the electrically operated crane capable of lifting a locomotive complete. There has probably never been gathered under one cover so diverse a variety of apparatus. In addition to the machine tools, the company shows several views of its works, and reproduces, with beautiful effect, the diplomas and medals it has been awarded from time to time.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ELECTRIC TRACTION SYSTEM FOR MADRAS, INDIA—A company has been organized in London, England, for the purpose of building an electric traction system in Madras, India. The company, which is designated as the Madras Electric Tramways (1904), Limited, has a capital of £100,000 and £50,000 in debenture stock. The directors are Sir H. C. Mance, J. W. Barclay, J. J. Courtenay and J. Gray.

CINCINNATI INDEPENDENT TELEPHONE COMPANIES UPHELD—Judge Nippert, of the Probate Court, Cincinnati, Ohio, decided on April 2 that the independent telephone companies have the right, under the statutes of the state, to use the streets of Cincinnati. Efforts to obtain franchises have been made for some time by the independent companies, which have applied to the city authorities. It is stated that the decision will be carried to the higher courts.

NEW YORK SYNDICATE BUYS MONTEREY POWER PLANT—A New York syndicate has secured control of the electric light and power plant at Monterey, Mexico. The Monterey Light and Power Company has been incorporated under the laws of the state of New Jersey, with a capital of $500,000, for the purpose of acquiring, enlarging and operating the plant. The president of the company is P. G. Gossler, of the engineering and contracting firm of J. G. White & Company, New York city, and the remodeling and extension of the system will be undertaken by that company.

HAWAII WIRELESS TELEGRAPH STATION OPENED—On March 23, for the first time since it was opened, the wireless telegraph system established at Honolulu, Hawaii, was working satisfactorily. With the aid of a substantial subsidy from the territorial government, the promoters have been able to put the line in good condition, and messages can now be sent with the assurance that they will be delivered. The system in use in Hawaii has been perfected by F. J. Cross, who first introduced wireless telegraphy in the islands. Messages are being sent from Honolulu to Oahu direct, a distance of 172 miles.

THE NORTH AMERICAN COMPANY UNDER SUIT—A suit to set aside the $20,000,000 consolidation of the Missouri Electric Light and Power Company, the Union Electric Light and Power Company and the Citizens' Electric Light and Power Company, now constituent corporations of the North American Company, of New York, has been instituted by Morgan Jones, of Denver, Col., in the United States Circuit Court at St. Louis. The complaint is that the merger was voted without the complainant's consent, and that, as a result, the stock of the Missouri Edison Company, of which he is a large holder, has depreciated in value.

FOR A NEW LOCKPORT POWER CANAL—The Niagara, Lockport & Ontario Power Company has closed a contract for the construction of a power canal from the Niagara river at Lasalle to Lockport. The company had a bill in the senate for an extension of the time and scope of its charter, which was passed by a vote of thirty-five to twelve on April 7. This charter permits the taking of enough water to develop 100,000 horse-power at the head of the gulf at Lockport. It is understood that the Iroquois Construction Company has undertaken the contract, and report has it that the Westinghouse company is heavily interested in the plan. Ex-State Engineer John Bogart will be constructing engineer. The eighteen-mile creek from Lockport to Lake Ontario will be used as a mill-race, and power can be developed all along the creek with a 220-foot fall to the lake. The new charter will authorize the transmission of electric power anywhere in New York and Ohio.

TRACTION COMPANY UNDERTAKES LARGE MORTGAGE—The Fort Wayne & Wabash Valley Traction Company has undertaken a mortgage of $7,500,000 with the Trust Company of North America, Philadelphia, Pa. This mortgage is given as a basis for first-mortgage consolidated five per cent gold bonds of the par value of $1,000, aggregating $7,500,000. The bonds are dated March 1, 1904, and are payable March 1, 1934. Of this amount, $1,875,000 is delivered at once, and $1,813,000 at the further order of the interested parties. The corporation is the traction company which is now operating lines in Fort Wayne, Peru, Logansport and La Fayette, and an interurban line between Wabash and Logansport. Its articles of incorporation provide that it may do business in Tippecanoe, White, Carroll, Cass, Miami, Wabash, Huntington, Allen, De Kalb, Noble, Lagrange, Steuben, Grand, Adams, Wells, Elkhart, St. Joseph, Fulton, Marshall and Kosciusko counties. Among the cities mentioned which are to receive traction service are Marion, Van Buren, Huntington, Warren, Decatur, Roanoke, Bluffton, Ossian, Goshen and Rochester.

NEW POWER CONTRACTS FOR SOUTH BEND, IND.—Power contracts are being negotiated between the St. Joseph & Elkhart Power Company, proprietor of the Hen Island dam project, and the South Bend Electric Company. The franchise allows the latter company the use of the surplus power produced by the former. This arrangement means that the promoters of the dam enterprise have decided to let their franchise—received at South Bend under the name of the South Bend Power Company—go by default, and furnish all the surplus power, after providing for Elkhart, Mishawaka and intervening points, to the local corporation for South Bend use. The hydraulic development at Buchanan is now furnishing power to the South Bend Electric Company under similar arrangements. As a result of this plan, all the important electric power plants in the valley of the St. Joseph river will be operated in harmony. Reliable and constant service will be assured, in view of the fact that the hydraulic developments at Elkhart, Twin Branches and Buchanan will be connected electrically and also helped out by steam power at Elkhart and South Bend. Should any trouble happen at the Buchanan plant, customers receiving power directly from Buchanan will be switched immediately upon the Twin Branch plant, and *vice versa*.

EXTENSIVE TRACTION CONSTRUCTION FOR NEW YORK-PHILADELPHIA LINE—At a meeting of the directors of the New Jersey Short Line Railroad Company, held at Philadelphia, Pa., April 7, a contract was awarded to the Railroad Construction Company, of Philadelphia, for thirty-six miles of electric railway at a cost of $2,225,000. The road to be built is a portion of the Philadelphia & New York Electric Railway, and will shorten the line about to be opened by more than seven miles. The contract calls for seventy-pound rails, to be laid upon extra heavy ties and stone ballast. The construction company is also required to build all the bridges across the Rahway and Raritan rivers, as well as overhead bridges for crossing all steam roads. The line to be built will extend from Milltown, Middlesex County, N. J., to the Baltimore & Ohio drawbridge over the Kill von Kull at Elizabethport. The contract also calls for the erection of a power-house and car barn, the necessary steam and electrical plant for generating the electricity and the required number of cars, which it is specified must be of the latest pattern. Each car will be equipped with a motor of 200-horse-power. The New Jersey Short Line Company was incorporated recently with a capital of $3,000,000. The company's incorporators were Richard D. Ashbridge, East Downington; A. A. Moyer and Thomas R. Heller, of Philadelphia; Thomas P. Curley, George H. B. Martin and John H. Sintzeo, of Camden. The management of the Philadelphia & New York line has announced that the first through cars between Camden and Jersey City will be run on May 10. Until the short line is built, the service will be operated by way of New Brunswick, Bound Brook and Westfield. The cutoff at Trenton has been completed, and the bridge near Delair will soon be ready for use. A half-hour service will be inaugurated between local points and an hourly service between Camden and Jersey City.

TELEPHONE AND TELEGRAPH.

EXIRA, IOWA—The Farmers' Mutual Telephone Company will extend a line to Audubon.

COVINGTON, TEX.—A new telephone line is being put in between this place and Blum.

REASNOR, IOWA—The Reasnor Telephone Company has been granted a franchise at Newton.

LEBANON, IND.—The Bell Telephone Company will shortly install a local system in Lebanon.

WATERLOO, IOWA—The United States Telephone and Telegraph Company will build a new office building.

DETROIT, MICH.—The Ottawa city council has decided to enter into a five-year contract with the Bell Telephone Company.

ROME, GA.—The Southern Bell Telephone Company has completed arrangements for a country line from Rome to Yancey Station.

LYNBROOK, N. Y.—The New York & Long Island Telephone Company has installed a large new switchboard in its Lynbrook exchange.

GONZALES, TEX.—The Postal Telegraph Company is now stringing a wire from San Antonio to Victoria by the way of Gonzales and Cuero.

DOTHAN, S. D.—The city council has granted Henderson and Cameron a franchise to construct a telephone line through the streets of the town.

PARIS, ILL.—The Citizens' Telephone Company has decided to construct a line from Vermillion, in Edgar County, to Dennison, in Clark County, and the work will be done immediately.

DETROIT, MICH.—The People's Telephone Company has sold all its Detroit property, including its mains in the streets and its uncompleted building, to the Michigan Telephone Company, for $175,000.

CHATHAM, VA.—The Southern Bell Telephone and Telegraph Company has installed its system at Dry Fork and Vaden's Mill. The American Telephone and Telegraph Company is adding four additional wires to its line through this county, making a total of ten wires.

SAN DIEGO, CAL.—The Home Telephone Company, which will soon construct a $250,000 system in this city, having already secured the franchise, has filed articles of incorporation. It is capitalized at $500,000. The incorporators are F. F. Graves, F. F. Boyce, William M. Godfrey, Arthur Wright and Charles E. Sumner.

CHEHALIS, WASH.—The rural telephone line which is being built to Mossy Rock, thirty miles east of Chehalis, is being pushed rapidly to completion. About seventeen miles of the east end of the line is completed, and only awaits the arrival of the telephones to be in operation. The line is to come from Mossy Rock by way of Silver Creek, Salkum, Ethel and Forest to Chehalis.

KANSAS CITY, MO.—The board of public works has ordered the city treasurer to return to the Home Telephone Company the $40,000 placed with the city as a guarantee that it would fulfill the terms of its contract. The report of the city electrician and city engineer shows that the company has a splendidly equipped plant, with over 7,000 telephones in active use, and an ultimate capacity of 24,000 telephones.

CANANDAIGUA, N. Y.—The Ontario & Steuben Telephone Company has just finished a prosperous year, but declared no dividends, owing to the fact that further extension of its lines is contemplated in the immediate future. Officers elected for the ensuing year are as follows: president, Hector Blake; secretary, William W. Holcomb; treasurer, Will Housel; auditor, C. L. Lewis; directors, George R. Granby, George B. Hemenway, D. D. Cottrell and C. L. Lewis.

JASPER, ALA.—The Southern Bell Telephone and Telegraph Company, it is reported, will begin at once extensive improvements on its system at Jasper, and on the long-distance lines running from this point to other places in Walker County. It is proposed to install a new plant, and several thousand dollars will be expended on the local exchange. It is believed that within a short while the work of rebuilding the lines running from Jasper to Corona, Oakman and Cordova will begin. A line to Carbon Hill is also contemplated.

NEW HAVEN, CT.—Arrangements have been made with the Southern New England Telephone Company, so that beginning on May 1 direct communication may be had between the local subscribers in East Haven and this city. A pair of trunk wires will connect the two systems, and local subscribers will install at their stations the type of instrument used by the Southern New England company. After the changes have been completed it will be possible for the East Haven subscribers to secure connection with points within and outside of Connecticut.

WHEELING, W. VA.—The work which has been in progress for some time on the connection of independent telephone lines between this city and Wellsburg has been completed, and the two lines are now connected. By connecting with the Wellsburg company's line, the National now reaches the following named cities and towns for the first time: Wellsburg, Bethany, Lazearville, in this state; Brilliant, Mingo, Steubenville, Wellsville, East Liverpool and Alliance, in Ohio, and Independence, West Middletown, Patterson, Buffalo, Burgettstown, McDonald, Oakdale and Carnegie, in Pennsylvania.

LESTON, PA.—It is said that a cooperative telephone system will be inaugurated in upper Bucks County in the near future. The residents between Quakertown and Riegelsville, along the line of the Quakertown & Easton Railroad, have interested themselves in the formation of a company to operate within the bounds of that territory. It is proposed to construct a telephone line along the railroad, with a telephone in each station. The farm houses in the adjacent territory will be connected with the same line, and at Quakertown the line will connect with the Bell system. The Bell company is arranging to extend its lines to Tinicum, Sundale, Erwinna, Uhlertown, Revere and other points in that part of the county.

LEGAL NOTES.

LEGAL RESTRAINT OF SALE—In the action brought by the Westinghouse Electric and Manufacturing Company against the Electric Appliance Company, Chicago, Ill., to restrain that company from selling or manufacturing the Gutmann wattmeter, Judge Kohlsaat, of the United States Circuit Court, Chicago, Ill., handed down a decision on March 26, sustaining the Tesla patents No. 511,559 and 511,560 on the rotating field split-phase system and granting the injunction asked for.

DIRECT-CURRENT ELECTRICAL MEASURING INSTRUMENT DECISION—The fundamental patent for the Weston direct-current electrical measuring instrument has been sustained as valid at the United States Circuit Court for the Southern District of New York. On March 2, 1904, Judge H. H. Wheeler held that patent No. 392,387, dated November 6, 1888, granted to Edward Weston for direct-current electrical measuring instruments and owned by the Weston Electrical Instrument Company, was good and valid and had been infringed by various types of direct-current instruments. On April 2, 1904, in the same court, Circuit Judge H. E. Lacombe granted a motion for preliminary injunction in the suit of the Weston Electrical Instrument Company *versus* the Keystone Electrical Instrument Company.

PERSONAL MENTION.

MR. G. H. MASTERS, of Berkley, Cal., has gone to Gardnerville, Neb., as electrical engineer for a mining company located at that address.

MR. F. D. PHILLIPS, formerly with the Electric Appliance Company, Chicago, Ill., is now identified with the Crescent Company, of which he has recently been elected vice-president.

MR. PAUL JONES, who was formerly connected with the Denver Gas and Electric Company, has been appointed secretary and treasurer of the Lincoln (Neb.) Gas and Electric Company.

MR. U. G. TOWNSEND, who was with the Bryan Telephone Company, Bryan, Ohio, has resigned to accept a position with the Williams-Abbott Electric Company, Cleveland, Ohio, as salesman.

PROFESSOR CHARLES BASKERVILLE, of the University of North Carolina, announced at a lecture before the Chemists' Club, New York city, April 8, that he had discovered two new elements which he designated as "Berzelium," after Berzelius, and "Caro-

linum," after the place of its discovery. These elements, it is understood, have been separated from thorium, and have their origin in the monazite sand of North Carolina.

MR. W. C. DILLON, formerly connected with the People's Home Telephone Company, Birmingham, Ala., in the capacity of superintendent, has resigned to accept a like position with the Memphis Telephone Company, Memphis, Tenn.

MR. FRANK R. PHILLIPS, assistant master mechanic of the Cleveland Electric Railway Company, Cleveland, Ohio, has accepted the position of master mechanic of the Cincinnati, Newport & Covington Traction Company, Covington, Ky.

MR. G. M. MORAN has been made superintendent of the Sedalia Gas and Fuel Company and the Sedalia Electric Light and Power Company, of Sedalia, Mo. He succeeds Mr. J. L. Griffith, who for the past four years has been superintendent of the companies.

MR. A. D. SCHINDLER, formerly division superintendent of the Santa Fe Railroad between San Francisco and Bakersfield, has been appointed general manager of the Pacific electric trolley railway system. Mr. Schindler takes the place of Mr. Epes Randolph, who retires.

MR. F. H. WHEELER, formerly chief engineer of the Imperial Finance and Construction Company, Toledo, Ohio, has resigned that capacity to enter the construction field under the name of Wheeler Electric and Construction Company, with offices at 305 Dearborn street, Chicago, Ill.

MR. P. G. GOSSLER, who is connected with the Montreal Light, Heat and Power Company, in the capacity of general superintendent and engineer, has tendered his resignation, to take effect May 1. Mr. Gossler has accepted the general managership of J. G. White & Company, New York.

MR. HARMAN S. SALT has joined forces with the Dale Company, of New York, and will hereafter ably fill the position of manager of that enterprising house. Mr. Salt was for many years identified with the Western Electric Company, and is an experienced and popular member of the electrical manufacturing fraternity.

MR. L. W. STANTON, consulting telephone engineer, Cleveland, Ohio, is supervising the installation of an all-cable telephone plant of between 200 and 300 instruments, for the Controller Company of America, on the World's Fair grounds, St. Louis. All the telephones used will be of the measured-service type, which are manufactured by the Controller Company of America. This plant will represent the highest type of modern telephony.

MR. W. F. WARDEN, president and general manager of the Burt Manufacturing Company, sailed for Europe on the steamer Celtic, of the White Star Line, on April 15. Mr. Warden will visit the foreign agents of the company in England, France, Germany, Belgium, Norway, Sweden, Denmark, Russia, and possibly Switzerland, Greece and Spain. Mr. J. Asa Palmer, secretary of the company, will have full direction of affairs in Mr. Warden's absence.

COLONEL W. S. ROGERS, one of the pioneers in the electrical business, has been appointed manager of the western office of the Chipman Electric Purifying Company. Mr. Rogers's office will be located in the Schofield Building, Cleveland, Ohio. The western office of the company will include all of the United States west of Pennsylvania. The "Chipman" process contemplates not only the purification of water for steam boilers, but the purifying of water for towns and cities. Plans are now being prepared, it is said, to furnish a plant with a capacity of 30,000,000 gallons per day for the city of Montreal, Canada.

MR. JOHN SCULLIN has been appointed director of transportation of the World's Fair. This appointment was made at a meeting of the exposition executive committee. Mr. Scullin has accepted this appointment at the earnest solicitation of his fellow directors, and will bring to this position a world-wide experience as a director of traction undertakings of magnitude. Mr. Scullin is one of the foremost railroad builders and managers in the West. He began as a contractor, doing much work on the Texas and other southwestern systems. Later he became a street railway magnate in St. Louis, building and managing for many years the Union Depot system, which was sold to the United Railways Company when the present consolidated system was formed. He was one of the owners of the St. Louis, Kansas City & Colorado line, which was sold to the Rock Island, and he also built, and is largely interested in, the St. Louis and North Arkansas line. Director Scullin will have jurisdiction over the intra-mural railway. The entire system of handling freight, exhibits and passengers on the site will be in his hands, and he will also manage the exposition's interest in the general service company. Up to the present time about 2,000 cars of exhibits have been received, out of an estimated total of 13,000. It is expected that there will be from 200 to 300 cars a day between now and April 30, if the exhibits are to be in an advanced state of completion before the opening.

ELECTRICAL SECURITIES.

Although there are many opinions extant regarding the future of prices, the events of the past week have been such as to hold out the hope that still better conditions will prevail. It is remarkable that, beginning with an adverse decision as far as large holding corporations were concerned, the market has shown greater stability and more susceptibility to increase in values. While, two weeks ago, there was a slight retrogression, this has been made up, and prices last week closed generally better than at any time since the first of the year. The unexpectedly good showing of the United States Steel Corporation in its latest financial and industrial report, and the increased earnings by the large railroad companies, indicate that business is picking up. It is also very probable that labor difficulties will be less widespread than in some time, the trade unions showing a tendency to conservatism which will make for harmony and progress. In the electrical and general contracting field there seems to be a disposition to accept conditions as good, and but very little complaint is heard in any quarter as to lack of opportunity for investment and profit-taking.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 9.

New York:	*Closing.*
Brooklyn Rapid Transit	46
Consolidated Gas	201
General Electric	163
Kings County Electric	183
Manhattan Elevated	143¼
Metropolitan Street Railway	117
New York & New Jersey Telephone	140
Westinghouse Manufacturing Company	175

Boston:	*Closing.*
American Telephone and Telegraph	123⅞
Edison Electric Illuminating	237
Massachusetts Electric	74¼
New England Telephone	121
Western Telephone and Telegraph preferred	80

Philadelphia:	*Closing.*
Electric Company of America	8
Electric Storage Battery common	57
Electric Storage Battery preferred	57
Philadelphia Electric	6
Union Traction	49⅝
United Gas Improvement	84

Chicago:	*Closing.*
Chicago Telephone	117
Chicago Edison Light	148
Metropolitan Elevated preferred	47½
National Carbon common	30
National Carbon preferred	100¾
Union Traction common	5⅝
Union Traction preferred	31½

Stockholders of South Side Elevated have authorized an increase of capital stock from $10,323,800 to $17,550,500, and directed the board of directors to dispose of the new shares, according to the plan proposed. The proceeds will be used to build third-track and new lines.

For the year ended February 29, the report of the Metropolitan West Side Elevated Railway is as follows: gross, $2,147,153; expenses, $1,042,338, leaving net of $1,104,815; other income, $6,037, a total of $1,110,846; charges, $894,745, leaving a surplus of $216,101, as compared with a deficit of $20,982 for the preceding year. No dividends were paid, however, during the year just ended, which accounts for the apparent increase. Byron L. Smith, F. L. Higginson and C. H. Requa have been elected directors, the latter replacing C. Sumner.

ELECTRIC RAILWAYS.

SACRAMENTO, CAL.—The Sacramento Electric, Gas and Railway Company has been granted a franchise to operate in Sacramento County.

HERKIMER, N. Y.—Work will shortly be resumed on the Mohawk extension of the Oneonta, Cooperstown & Richfield Springs electric railway.

PITTSBURG, PA.—A large force of men is at work building the new electric road which will connect West View with Bellevue. This line will be finished before summer.

SIOUX CITY, IOWA—The Sioux City Traction Company will make improvements this season costing $50,000. Materials are arriving for double-tracking some of the lines.

UTICA, N. Y.—Construction on an electric railroad, it is stated, will soon begin from Binghamton, *via* Owego to Ithaca, to connect with an already completed line to Elmira.

MARION, IND.—Work is being rushed on the Indiana Northern Traction Company's line from Wabash to Marion, and it is hoped to have the road completed by the middle of June.

JAMESTOWN, N. Y.—The new power-house of the Chautauqua Traction Company, for which ground was broken last April, is practically completed, and it is expected that the equipment will be in running order by the middle of May.

CUMBERLAND, MD.—Work has been begun on the new electric road to connect Westernport with Keyser, W. Va., and the line will be pushed rapidly to completion. It will connect with the Cumberland & Westernport Electric Railway.

WILMINGTON, DEL.—Consolidation of the Wilmington & New Castle and the Wilmington & Delaware City Railway companies, under the name of the Wilmington, New Castle & Southern Railway Company, was ratified recently at a meeting of the stockholders.

TOPEKA, KAN.—The Arkansas Valley Transit Company, of Hutchinson, has been incorporated with a capital of $10,000. The purpose of the company is to buy the old horse car line in Hutchinson and turn it into an electric line; also to build a line from Hutchinson to Wichita.

YORK, PA.—The work of trolley line extension has been resumed, beginning on the Wrightsville line. This line will go through to the Susquehanna river. The York Haven line is now completed as far as Mount Wolf, and may be met by a line running south from Lewisberry, which will complete a chain of trolley lines from York to Harrisburg.

SOUTH BEND, IND.—D. M. Shively, of this city, is interested in a project to run an electric line from Celina, Ohio, to Montpelier, connecting with Geneva. The following are associated with him: W. J. Heeter, J. H. Hardison, D. M. Shively, Edward F. Walsh, A. G. Briggs, S. W. Hale and C. D. Porter. It is expected that the road will be built this summer.

HARRISBURG, PA.—The charter and articles of association of the Hummelstown & Campbelltown Street Railway Company have been filed at the recorder's office, in Lebanon. The president and directors are as follows: M. S. Hershey, Lancaster, president; William H. Lebkicher, Lancaster; C. S. Maulfair, Annville; George B. Ulrich, Annville; John E. Snyder, Lancaster.

GUTHRIE, OKLA. TER.—The territorial secretary has granted to the Oklahoma City, Lexington & Sulphur Springs Electric Railway Company a charter to build an eighty-mile line from Oklahoma City to Sulphur Springs, Ind. Ter. The principal incorporator is Charles Stewart, of Parkersburg, W. Va. The company has a capital of $1,000,000. Sulphur Springs is the government health resort.

NEW WESTMINSTER, BRITISH COLUMBIA—It is reported here that the electric railway system now being constructed from Seattle to Blaine will connect there with the British Columbia Electric Railway system and run direct into the cities of New Westminster and Vancouver. If this is done the latter company will have to build from this city to Blaine, a distance of a little over twenty miles.

MIDDLETOWN, DEL.—Agents of the Odessa & Middletown Railway Company have gone over the proposed route of the extension from Middletown to Smyrna and have secured most of the right of way. It is proposed to commence work on the road as soon as possible, and it is expected the Delaware City line will be extended to Odessa, to connect with the railway there. This will give complete trolley service between Wilmington and Smyrna.

PUEBLO, COL.—A plan is being arranged by which the Interurban Railway and Power Company will consolidate with the Traction company for the purpose of building a street railway along Northern avenue and extending from Carlile park through Bessemer to Riverview cemetery, and then down the Vineland road to Avondale, a distance of eighteen miles. A recent extension of the franchise given by the city council to the Interurban company in the interests of a Boston syndicate has made the deal possible.

PEKIN, ILL.—The interurban company which proposes to build a line from Bloomington to Lincoln, Springfield to Pekin and Peoria, has organized and has published a list of the stockholders of the project. This line will run through Tazewell County for a considerable distance, running from Peoria to East Peoria, thence *via* Groveland, Tremont, Hopedale, Boynton to Lincoln. A cross line will be run from Morton west to a point on the main line north of Groveland, following the main line south to the south line of Groveland township and thence west to Pekin.

PHILADELPHIA, PA.—James Smith, Jr., receiver of the Atlantic Coast Electric Railroad Company, has filed his report in the United States Circuit Court, showing that the road is in good financial condition and capable of first-class operation. The report shows that the receipts for the year ending January 31, 1904, were $309,520.53; disbursements, $362,064.41, leaving a balance of moneys on hand at the date of the report of $47,456.12. The report further shows that there were 4,048,671 passengers carried in the year, and that the operating expense a mile was $13,491.

COLFAX, WASH.—The county commissioners have granted a franchise over certain county roads and highways in Whitman County to S. J. Crutcher, A. J. Smith and associates of Pine City, for the construction of an electric railway. The line proposed will run from Spokane through Spangle, Pine City and St. John to Colfax. The Washington Water Power Company is behind this line and will supply the capital. It is expected that work will commence this summer and be pushed to completion as fast as labor can build it. The line will tap a very rich section of country that is now somewhat isolated from rail transportation. The preliminary surveys will be made within a few weeks.

JACKSON, MICH.—G. A. Mullins, of Chicago, representing the Western Engineering and Construction Company of that city, definitely announces that his company intends to build an electric line from St. Joseph to Kalamazoo. According to present plans, work on the road will commence as soon as weather conditions are favorable. The company already has control of about six miles of grading done east from St. Joseph last summer on an electric railway proposition which fell through. Mr. Mullins stated that the finances necessary for the road from Kalamazoo to St. Joseph are already assured. As now planned, the new road will pass through Hartford, Lawrence and Paw Paw, and so to Kalamazoo. Many farmers along the proposed line have offered free right of way through their property.

DES MOINES, IOWA—The St. Joseph Interurban Railway Company has been incorporated here with a capital of $100,000. The capital stock is divided into 1,000 shares. The incorporators are: George C. Sims, Des Moines; A. C. Plummer, Altoona, Iowa; Alice M. Butler; John C. Landis, Jr., St. Joseph. The offices and principal power-house of the company will be in St. Joseph. The line will run through Buchanan, Platte and Andrew counties. The northern terminal point of the company will be Savannah, and the southern Platte City, the intermediate points being St. Joseph, DeKalb and Wallace. This will give a total mileage of about sixty miles. The company will do a freight as well as a passenger business, one of the chief objects being to haul live stock to the St. Joseph stock yards. The work of grading and laying track will begin as soon as the right of way is attended to, which will probably be early in the summer.

ELECTRIC LIGHTING.

NEW FREEDOM, PA.—The borough is to have an electric light and water plant, which will cost $13,600.

ERIE, PA.—The city hall committee has awarded the contract for lighting the city buildings to the Erie company.

GLENS FALLS, N. Y.—The trustees of the village of Lake George are considering the question of lighting the village electrically.

BRYAN, TEX.—The city council has granted to H. B. Dorsey a franchise to erect electric light wires and poles on the principal street of the village.

TARENTUM, PA.—The citizens of Tarentum have decided to maintain and improve the municipal lighting plant. The cost of repairs will be $10,000.

NEW HAVEN, CT.—The Sheffield Scientific School at Yale is to have an electrical plant sufficiently large to light all the buildings in connection with the school.

CHARLOTTE, N. C.—A large substation will be erected here by the Catawba River Company at an early date for the distribution of power throughout the city.

DENVER, COL.—George T. Beck has been granted an exclusive franchise to supply electric lights to the residents of Cody, and will erect a plant within the next two months.

COLUMBIA, S. C.—The Georgetown Electric Company is considering the installation of an electric light plant in Florence, similar to the one in operation in Georgetown.

WATKINS, N. Y.—The property and franchise of the Watkins Consolidated Gas and Electric Company have passed into the possession of the United Power and Traction Company, of Philadelphia.

BUTLER, PA.—The light committee has closed a contract with the Butler Light, Heat and Motor Company for lighting the streets of the city for five years at $80 per year for each arc light. The number of lights will be increased from 80 to 110.

OLD TOWN, ME.—John Conners, Ira D. Conners and George T. Sewall are said to be interested in a plan to utilize the water power of the Penobscot river near Marsh Rips. A power plant is to be erected and current furnished to neighboring manufactories.

BOSTON, MASS.—The Cape Light, Heat and Power Company, of Mansfield, Mass., has petitioned the gas and electric light commissioners for authority to issue $31,000 additional capital stock to build and equip an electric light plant in Provincetown, Mass.

BOSTON, MASS.—The gas commissioners have authorized the Cambridge Gas and Electric Light Company to issue $100,000 of capital stock. This is for the purpose of making extensions and improvements, and will bring the company's total capitalization up to $700,000.

BOSTON, MASS.—It is said the Edison company will soon abandon the plant in Woburn recently purchased for the Woburn Light, Heat and Power Company, and serve customers in that district from a central plant in Boston through a line of underground wire, to be at once installed.

UTICA, N. Y.—At the annual meeting of the stockholders of the Utica Gas and Electric Company the following were elected directors for the ensuing year: A. N. Brady, William E. Lewis, William T. Baker, Charles S. Symonds, Charles B. Rogers, John F. Maynard, Daniel N. Crouse, M. J. Brayton and Samuel A. Beardsley.

OMAHA, NEB.—The Omaha Electric Light and Power Company is planning to spend $75,000 in improvements on the plant this spring. Work is going on for a thirty-six-inch intake to supply water for condensing purposes. Within a few weeks the new machinery will be installed. The largest item is a steam turbine and electrical generator, which will add 2,000 horse-power to the capacity of the plant. The present capacity is 3,500 horse-power.

CHARLESTON, S. C.—The committee on lights of city council has completed arrangements for a larger number of street lights at lower rates. The new contract will go into effect on July 1 next. By this contract the city will save $5,745, paying $26,223 instead of $31,968 per year. The balance will be expended in increasing the number of lights. The Consolidated company has reduced the cost of arc lights from $97.50 to $80, to be followed next year by a reduction to $75.

YORK, PA.—The superstructure of the York Haven Water and Power Company, which was demolished by the ice flood in the Susquehanna river a few weeks ago, will be rebuilt at once. The company has arranged to construct a temporary wooden building over the machinery. A temporary switchboard also will be installed. This will enable the company to operate the plant while the permanent brick structure is being erected, and consequently there will be no delay in starting up the plant.

DUBUQUE, IOWA—A new dynamo has been received by the Union Electric Company and has been installed in the plant on Eighth and Washington streets. It weighs fourteen tons and will be connected with a 500-horse-power engine. The new dynamo was necessary because the power plant on Sixth street was overtaxed, and it will be connected with that plant. There are now at the plant six generators with a capacity of developing 520 kilowatts. The new generator will develop 200 kilowatts and will be run at full capacity.

FREMONT, OHIO—The Fremont Power and Light Company has been incorporated with a capital of $350,000. The company will merge three water powers above Fremont on the Sandusky river and combine them into one large power. A dam twenty feet high will be constructed, and a modern power-house erected, equipped to operate with steam as well as water. The company purposes to furnish light and power to factories and private consumers. The stockholders have elected the following officers: president, Frank Heim; vice-president, J. W. Baxter; secretary and treasurer, D. B. Love.

GLASTONBURY, CT.—Plans have been prepared for the development of a water power on Roaring creek by the Glastonbury Power Company. Two dams are to be built. The one for the storage reservoir will be forty feet high and 650 feet long, while the other will be 100 feet high and 250 feet long. The power-house will be of steel and concrete, and its dimensions will be forty by sixty-six feet. About 2,600 horse-power will be developed. The company has a capital of $350,000, and among those interested in it are Lewis W. Ripley, Henry S. Goslee, D. Willard Williams, James S. Williams and J. H. Hale.

YREKA, CAL.—W. H. Roberts, M. T. Jones, A. F. Reiser, E. C. Parshall, Ellen Smith, Anna Coyle, S. J. Smith and D. C. Earhart, all of this county, have incorporated a company to be known as the Little Shasta Power Company, for the purpose of acquiring electric and other power and for building and maintaining electric lines. The principal place of business will be at Hornbrook, in this county, and the term of incorporation is to be fifty years. The following have been elected to serve as directors for the first year: W. H. Roberts, D. C. Earhart and S. J. Smith, of Hornbrook, and E. C. Parshall, of Klamathon.

ONEIDA, N. Y.—The waters of Limekiln falls, on Oneida creek, in the vicinity of Munnsville, are to be harnessed next summer to generate electricity for motive power. The project of establishing a power plant at this point was advanced about a year ago by De Witt C. Hadcock, of this city. Since that time the place has been inspected by electrical engineers and the project pronounced feasible. Several financial men of this city have agreed to back the project and the plant is to be built by August next. The water that is to be utilized has a fall of about 300 feet in a distance of three-quarters of a mile. For the entire length the water falls in numerous cascades from one foot to ten feet in height, and this series of cascades is known as the Limekiln falls. At the top of the falls, at what is known as Sartwell's Mill, it is proposed to build a dam twenty-five feet high. The water will be carried from the dam through a viaduct a distance of three-quarters of a mile. Here a steel standpipe 200 feet long will be erected. It is planned to carry the electricity from the plant to Oneida, where it will be furnished for use in manufactories only. The cost of erecting the dam, viaduct, standpipe, power-house and carrying the electricity to Oneida, including the installation of transformers, is estimated at $130,000.

INDUSTRIAL ITEMS.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., will remove its offices on April 20 from 183 Lake street to 184 Lake street.

THE GARTON-DANIELS COMPANY, Keokuk, Iowa, has recently had published a catalogue in which is illustrated and described "Garton" lightning arresters.

THE CROWE METAL MANUFACTURING COMPANY, Chicago, Ill., manufacturer of name-plates, has issued its catalogue illustrating many designs. Catalogue will be sent on request.

THE CRESCENT COMPANY, Chicago, Ill., manufacturers' agent of electrical specialties, has removed to 216-22 Omaha Building, where it will have ample facilities for its increasing business.

THE DAYTON ELECTRICAL MANUFACTURING COMPANY, Dayton, Ohio, illustrates, describes and lists in a complete little catalogue which it is distributing, the "Apple" ignition apparatus which it manufactures.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., reports large sales of Packard lamps during the winter just past. In fact, these sales have exceeded all previous records. The company claims that this is merely a result of maintaining an extremely high efficiency in the Packard product.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, is distributing its bulletin No. 1025 describing "Bullock" oil-insulated, steel-type transformers. These transformers are made in sizes ranging in capacity from 37½ to 250 kilowatts, in self-cooled, and from 100 to 2,000 kilowatts, in water-cooled type.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has just sent out two interesting bulletins, Nos. 6 and 7. Bulletin No. 6 contains an article by Mr. F. R. Field, on "Electric Haulage *versus* Mule Haulage in a Colorado Mine." In bulletin No. 7 is an article by Mr. C. B. Peck, on "An Alabama Electric Coal Haulage Plant." Both of the bulletins will be sent on request.

THE SIMPLEX ELECTRIC HEATING COMPANY, Cambridge, Mass., has just issued a very complete catalogue of its electric heating specialties. The catalogue is fully illustrated and many forms of cooking utensils are listed. There are also listed a large variety of other electrical appliances, such as glue pots, soldering irons, curling-iron heaters, heating pads, instrument sterilizers, radiators, foot warmers, laundry and tailors' irons, etc.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., manufacturer and electrical engineer, has increased its capital to $2,000,000. The company, which is one of the largest of the independent electrical manufacturers, was organized in 1892 by Dr. Schuyler Skaats Wheeler and Professor Francis B. Crocker on a relatively modest basis. It now has fifteen branch offices from Boston to San Francisco, and does an extensive business in electrical power apparatus.

THE WYCKOFF PIPE AND CREOSOTING COMPANY, INC., Stamford, Ct., reports that the Public Service Corporation of New Jersey has purchased from it several miles of "Wyckoff" creosoted conduit for its construction work this season, and the Bell Telephone Company, of Philadelphia, Pa., has bought over twenty miles of "Wyckoff" creosoted conduit for its underground work in Philadelphia this season, together with a large amount of creosoted lumber to lay on top of the conduit to protect it.

THE RHODE ISLAND ELECTROMOBILE COMPANY, Providence, R. I., announces a heavy-service test which its electric carriage recently endured on a trip from New York city to Yonkers and back. The actual distance run by the carriage was fifty-nine and one-half miles, and it is stated that the equipment was in such condition that ninety miles could easily have been made. There are thirty-two cells in the wagons, each weighing twenty-nine pounds, and these are rated with a capacity of ninety miles on one charge day after day.

THE LANYON ZINC COMPANY, 607 Carleton Building, St. Louis, Mo., one of the largest individual producers of spelter in the West, has reprinted from the *Lead and Zinc News*, St. Louis, Mo., a valuable paper entitled "Two Stories of Zinc." This takes up in detail the production and processing of spelter and the manufacture of sheet zinc. The booklet is illustrated with half-tone drawings and diagrams. In addition to this there is a map of the United States zinc mining districts and locations of towns or cities in which are located zinc spelters or oxide works. Mr. F. E. Drake is the president of the Lanyon Zinc Company.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., is continually adding to its list of "Exide" battery depots, the list now including twelve cities. The rapidly increasing demand for "Exide" batteries has necessitated the opening of new depots at central points. Each of these depots is in charge of an experienced storage battery man and carries a full line of battery material, so that users of electrical vehicles, equipped with "Exide" batteries, can conveniently obtain supply parts. Stations are located in New York city, Philadelphia, Pittsburg, Buffalo, Chicago, Denver, Boston, St. Louis, Rochester, Toledo, Detroit and Columbus.

THE EUREKA ELECTRIC COMPANY, Genoa, Ill., has produced a decided novelty in the form of an advertising folder in imitation of its model No. 99 telephone. This has all the appearance of a wall set with hinged door, which on being folded back shows the interior appointments and wiring. The company is now running its factory overtime and reports a most successful spring outlook for business. The factory has been extremely busy for the past ten weeks and orders are coming in heavily on a new switchboard apparatus, which is securing a high endorsement of all who have seen it. The company will be pleased to send its latest 1904 bulletin and printed matter describing its well-known line of apparatus.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a mailing circular of peculiar and timely interest. This combines, in addition to a splendid map in colors, a quantity of information concerning the status in the Russo-Japanese situation. The advertising text is characteristic, and the following is worth quoting: "While the war in the Far East is attracting so much attention, we are engaged in a most vigorous campaign after business. With such aids as Okonite and I. X. L. wires, Okonite tape and Manson tape, Pittsburgh transformers, Columbia lamps, D. & W. material, and Williams-Abbott telephones, backed by ample facilities and every modern system to ensure proper and prompt handling of business, we hope to capture your orders."

THE GOULD STORAGE BATTERY COMPANY, New York city, N. Y., reports that among recent contracts closed by it are the following: Chambersburg, Greencastle & Waynesboro Railway, Waynesboro, Pa., two floating batteries, one of 242 cells, type O-11, and one of 244 cells, type O-9. Additional plates for the Lexington Street Railway Company, Lexington, Ky., increasing the company's output to 352 kilowatts. Elder & Johnson, Dayton, Ohio, sixty cells of 400-ampere discharge, with a "Gould" C. E. M. F., booster for elevator regulation. Bank of Montreal, Montreal, Canada, sixty-one cells, with a discharge of 960 amperes, with motor-driven end-cell switch. Isolated and residential plants for C. C. Williams, Cohassett, Mass.; W. T. Smith, Elks, Nevada, and United States navy yard, New York. Also six central battery system telephone plants at different points.

THE BURT MANUFACTURING COMPANY, Akron, Ohio, manufacturer of the Cross oil filter and the Burt exhaust head, has recently received an order from one of its foreign agents at Durban, South Africa, for thirty gross of oil filters, and another from its agent at St. Petersburg, Russia, for oil filters for the Russian Government. The Burt Manufacturing Company has recently produced an interesting photograph showing a thirty-inch exhaust head which it recently made for the Jones & Laughlin Steel Company, Pittsburg, Pa. This exhaust head is ten feet high, nine feet four inches in diameter, and weighs 7,200 pounds. Mr. W. F. Warden, president and general manager of the company, sailed for Europe on the steamer Celtic, of the White Star Line, from New York, on April 15. Mr. Warden goes in the interest of his company, which has a large foreign trade in all the principal countries of the world. This trip will be confined to visiting agents in England, France, Germany, Belgium, Norway, Sweden, Denmark and Russia, and, if time permits, Switzerland, Greece and Spain. In Mr. Warden's absence, Mr. J. Asa Palmer, secretary of the company, will have full direction of its affairs.